ESE Science Context

MODLAND Products: Surface Radiation Product Suite

The Earth Radiation Budget (shortwave:albedo,longwave:temperature) is key to understanding the global climate (and climate change).
For a better understanding/modeling of the Earth system, the atmosphere and surface need to be de-coupled (determining the influence of atmospheric forcing on downward and upward radiation).

MODIS will provide critical parameters for surface radiation budget:
- Surface reflectance - > BRDF, Albedo
- Surface temperature and emissivity
- Snow product plays a critical role in the Earth Albedo (In addition snow plays an important role in the hydrological budget).

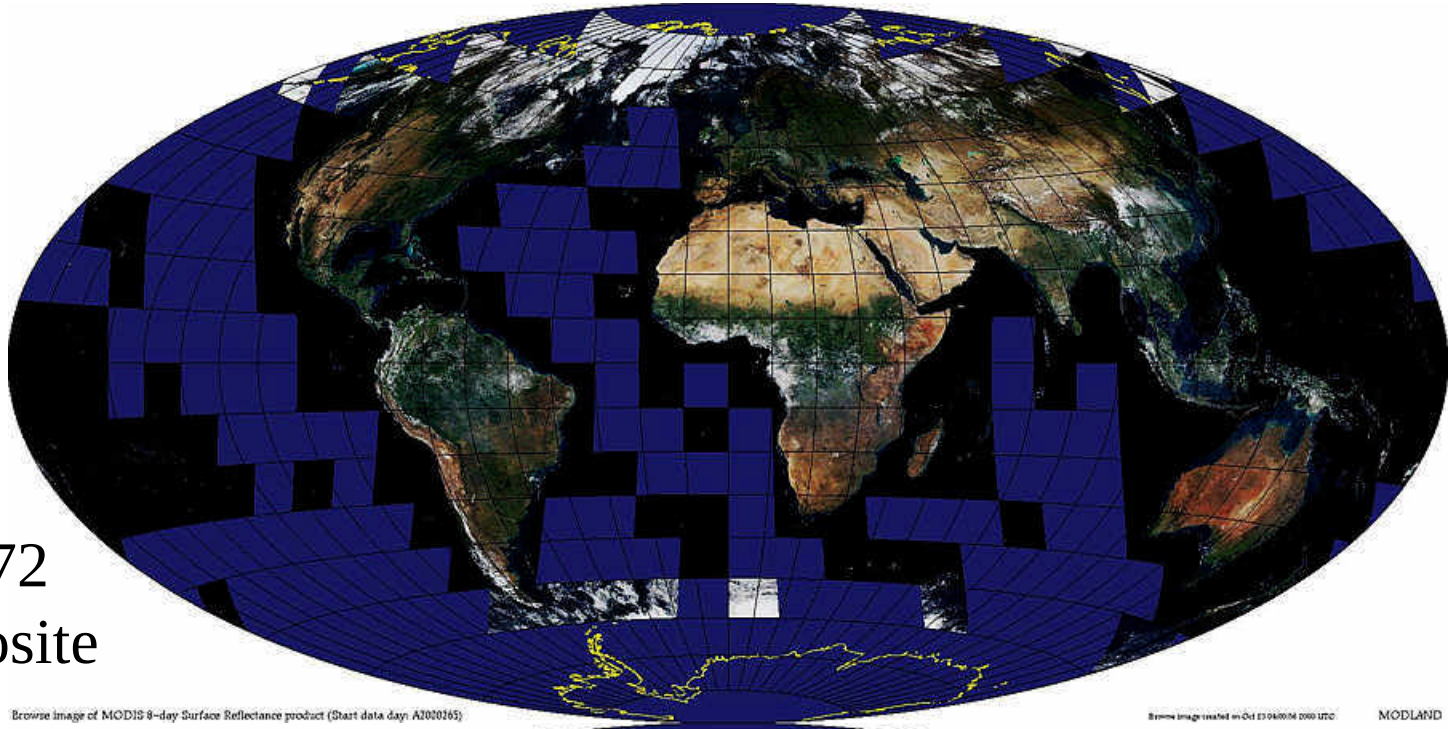
MODIS surface reflectance product

E. Vermote, F. PetitCollin, J. Ray, N. El Saleous

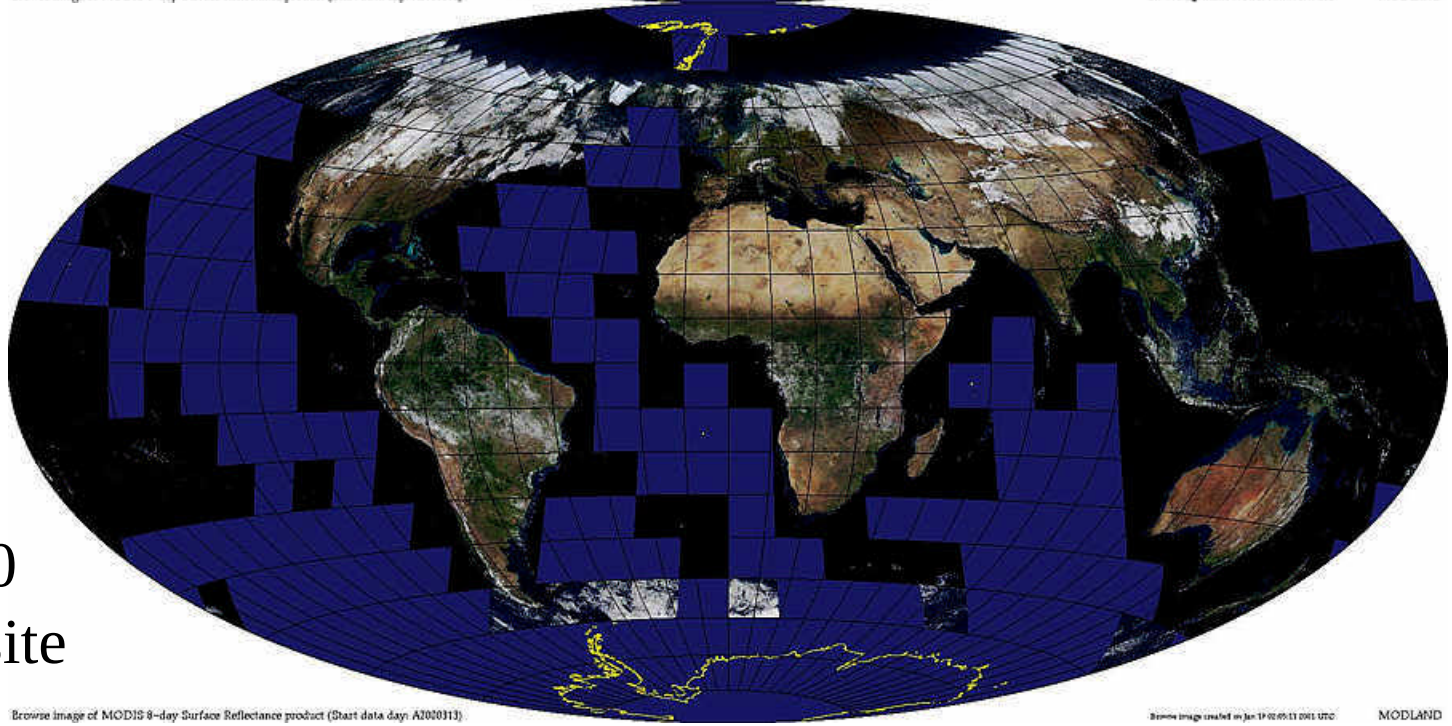
Status of surface reflectance product

- Beta version (no aerosol correction) distributed since August 2000 (data day 161-2000)
- Aerosol correction for data acquired after end of September 2000 (data day 273-2000)
- Overall Product much improved over previously available data sets - areas for improvement prioritized.
- Validation underway

265-272 composite



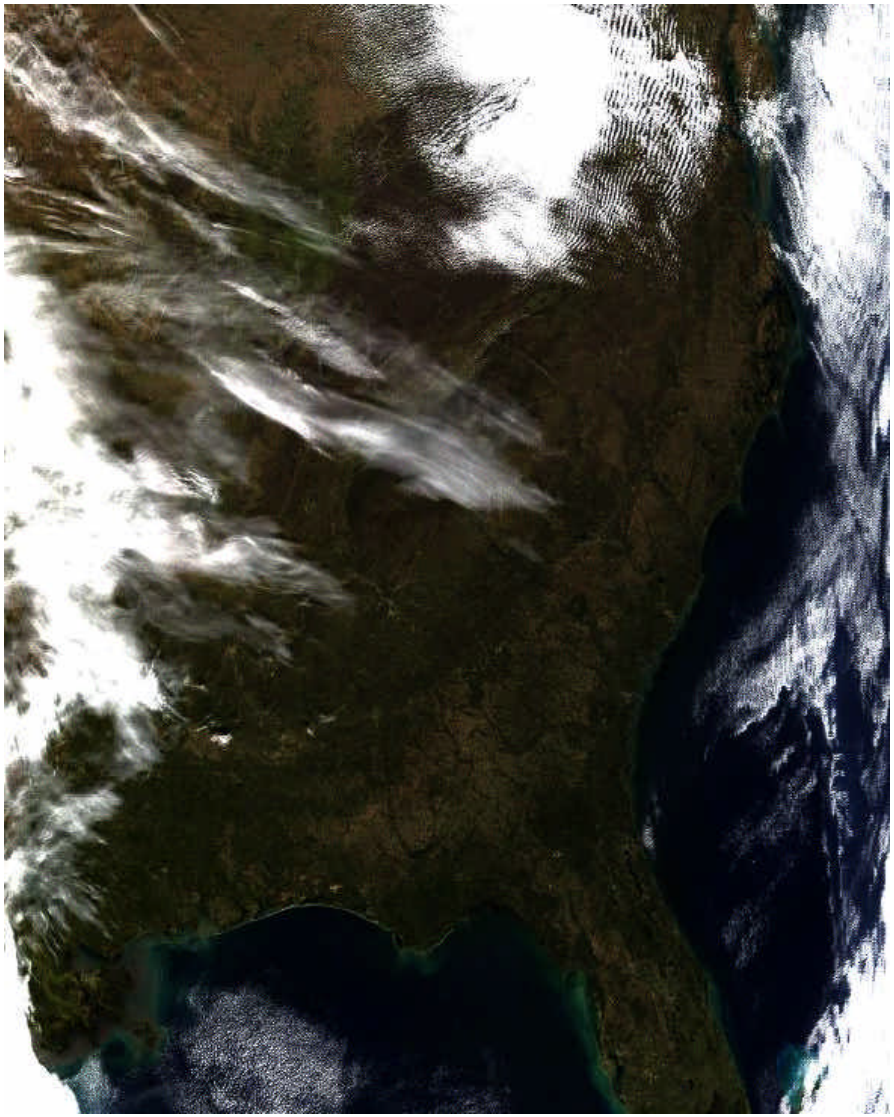
313-320 composite



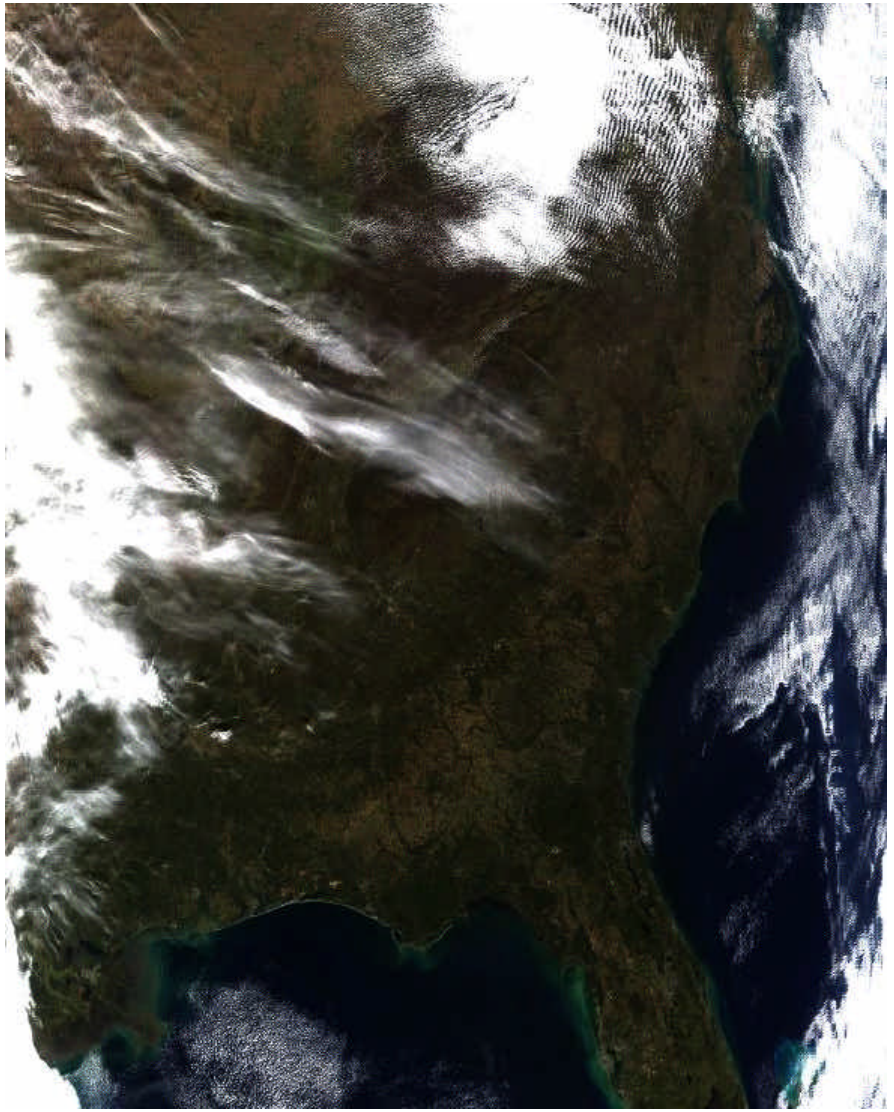
Priority improvements to the surface reflectance product

- Aerosol retrieval algorithm improvements
  - input finer resolution aerosol input (~18km ->1km)
  - reduce snow contamination
  - extension of aerosol retrieval to brighter targets
- 8 day composite improvements
  - cloud shadow filtering
  - near nadir selection (after aerosol correction)
- Extension to thermal infrared
  - Reflectance and emissivity (3.75mic to 12mic)
- Need improvements to cloud mask product

Test of the new aerosol algorithm for atmospheric correction

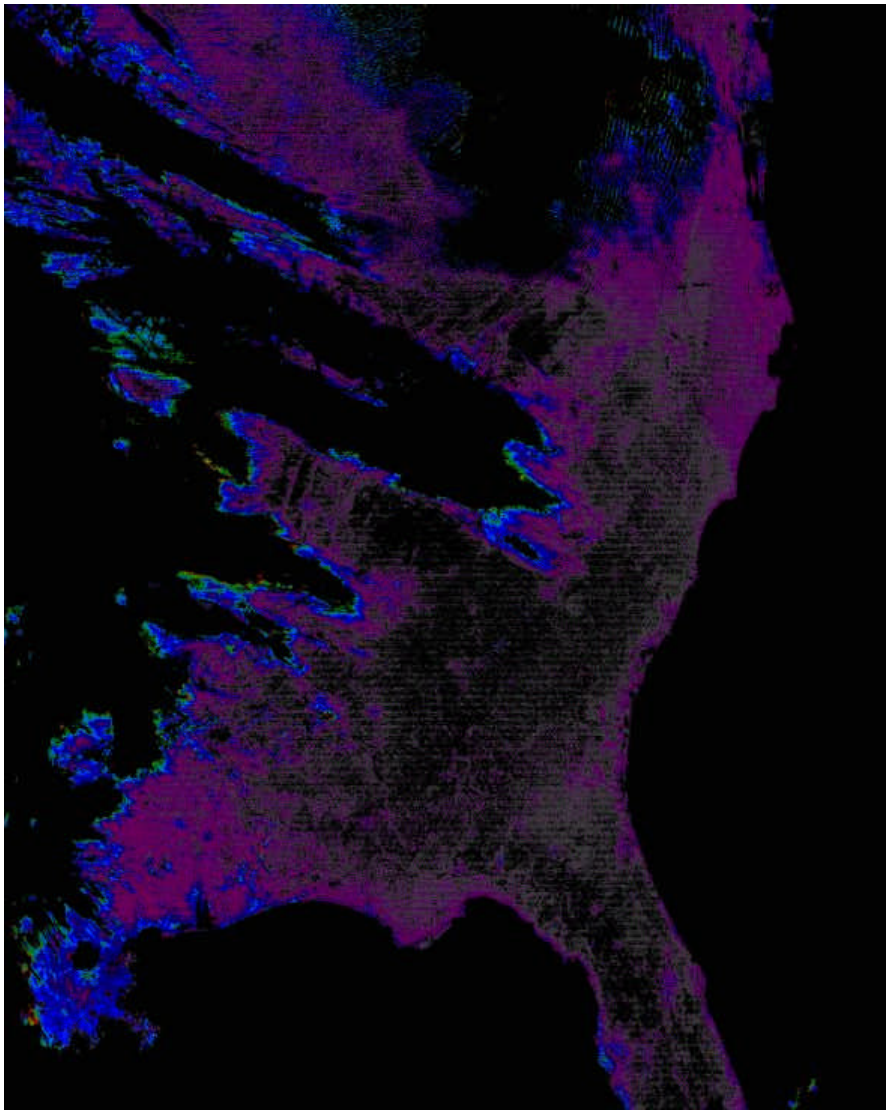


Corrected for Aerosol

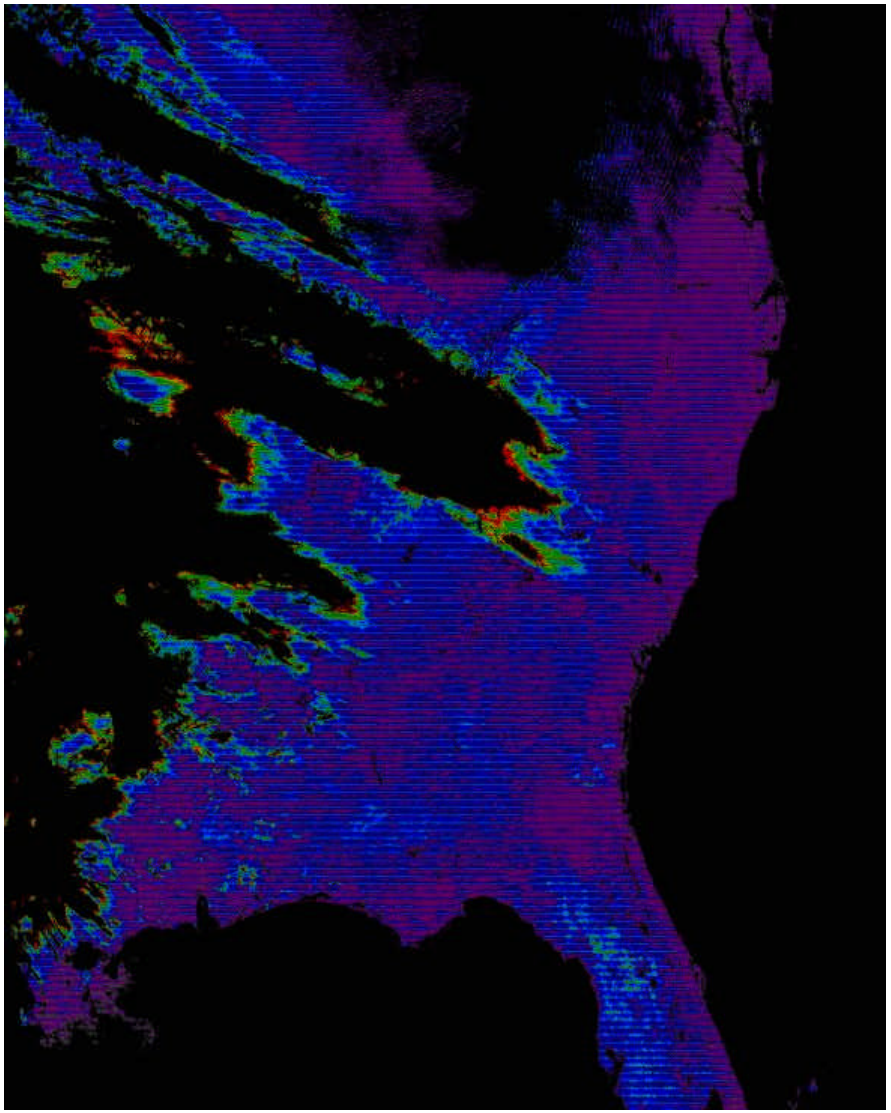


Uncorrected

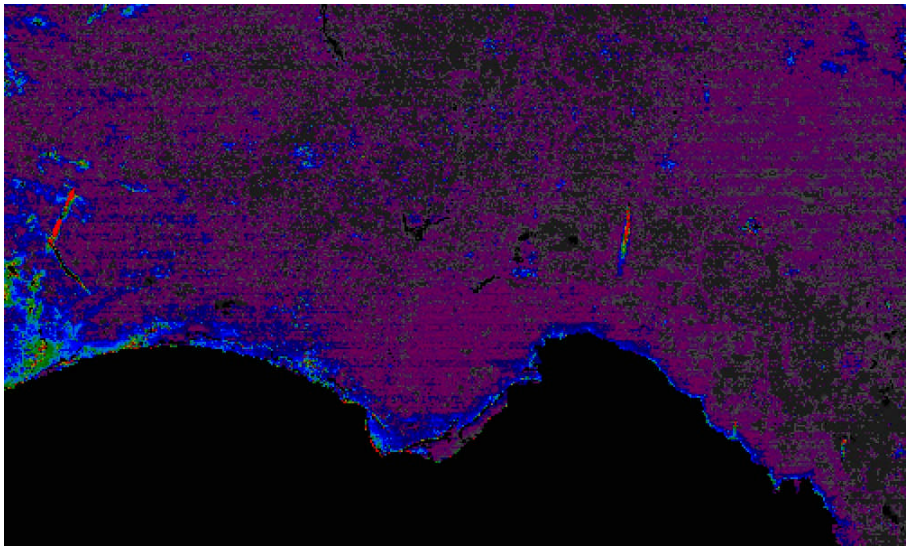
New Aerosol Retrieval (470nm)



Cirrus Band 26

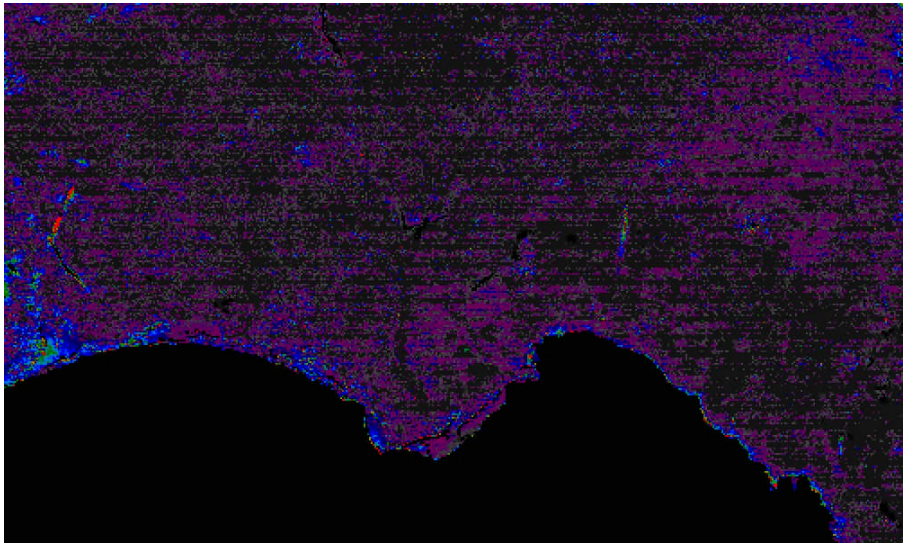


Details over Eastern U.S.



Aerosol optical thickness 470nm

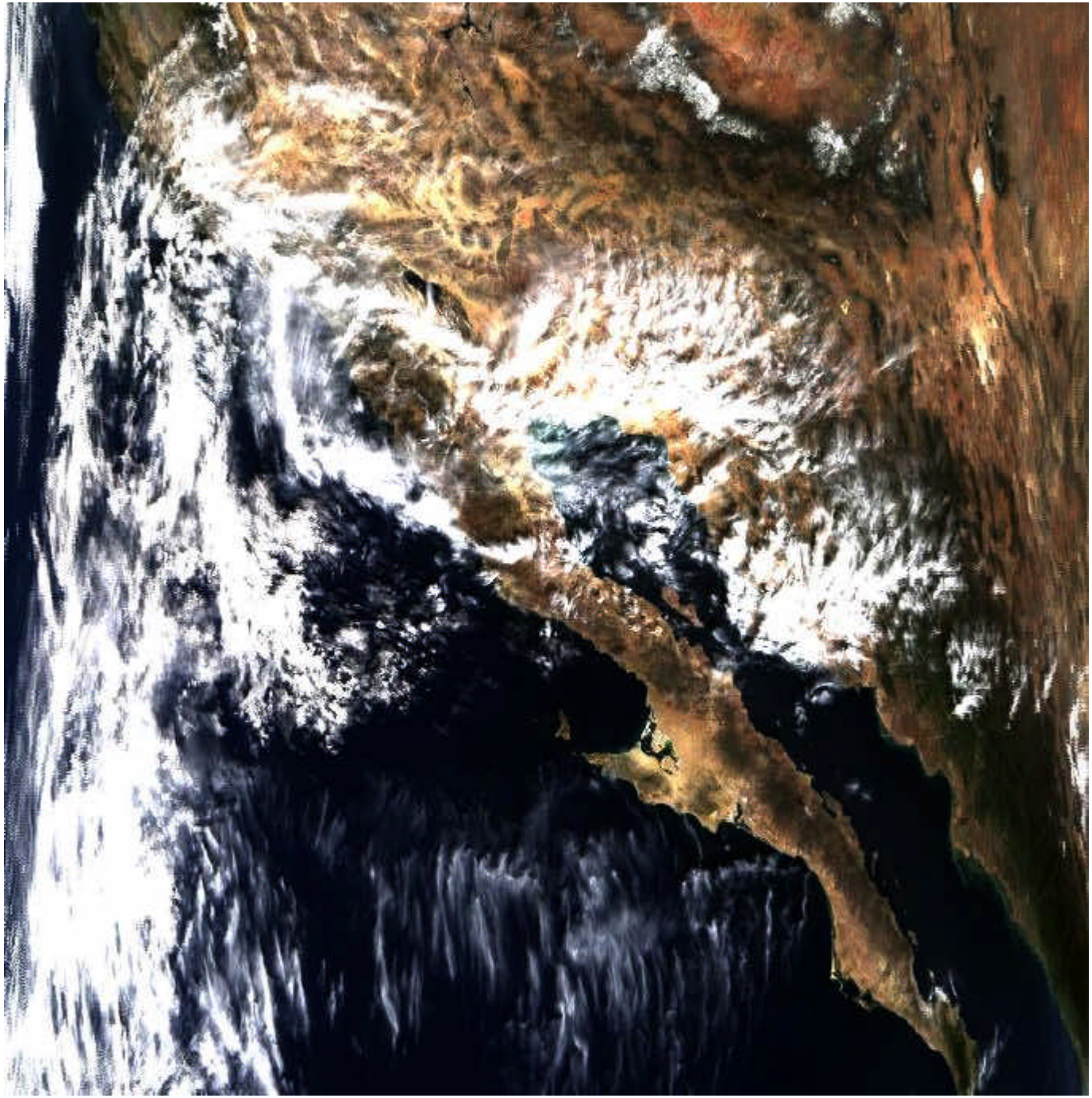
Corrected for aerosol



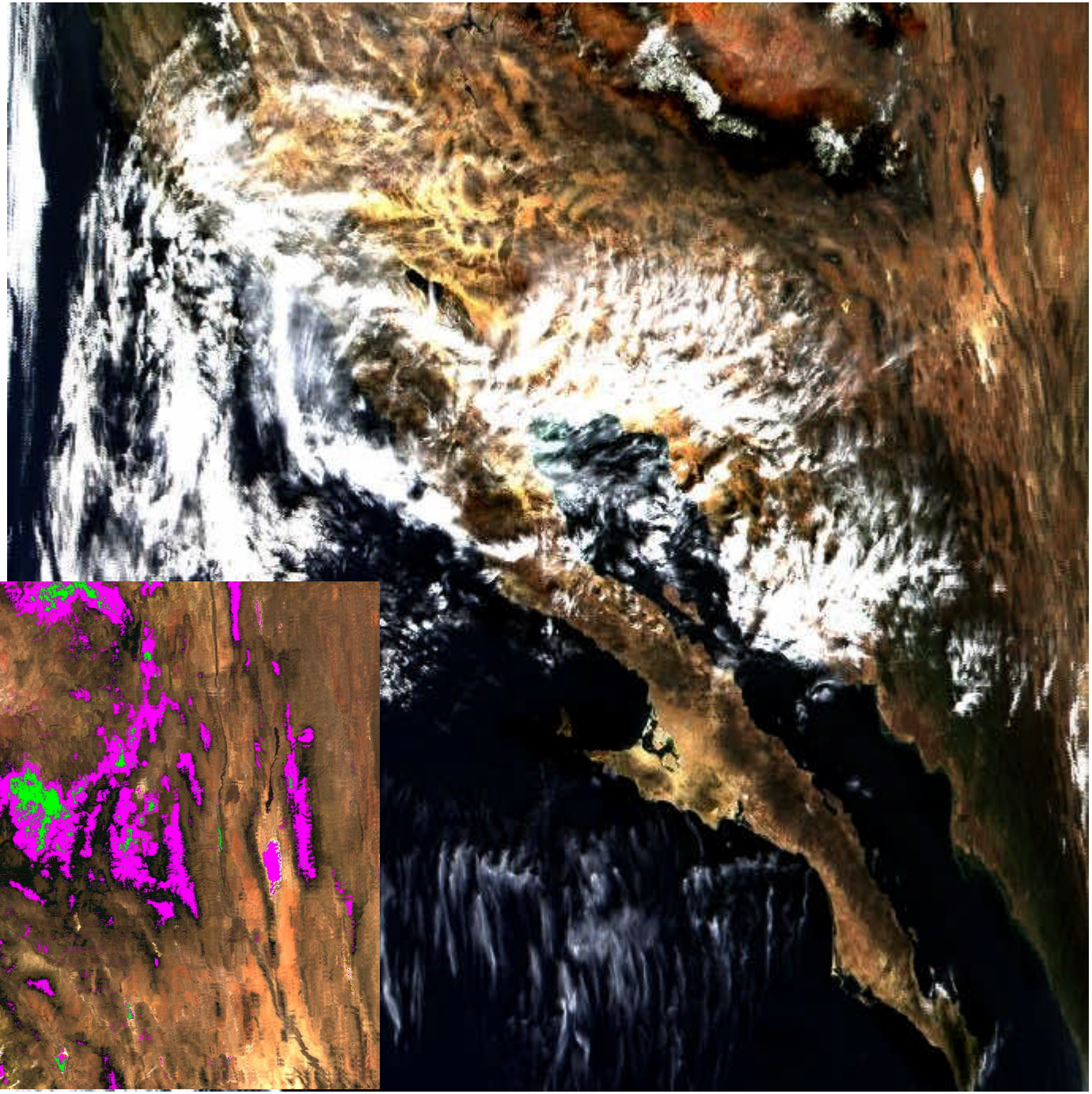
Aerosol optical thickness 670nm

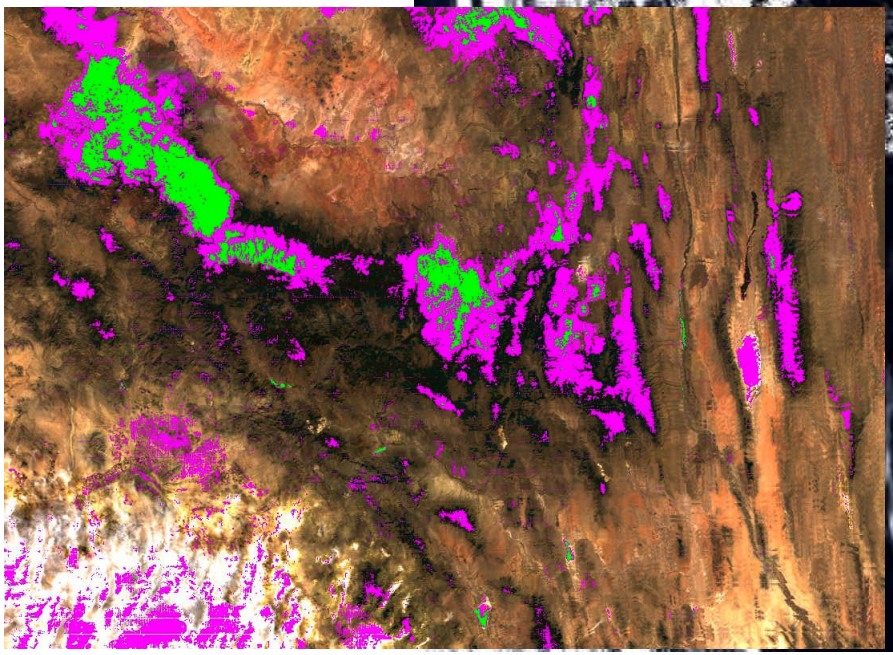
Not corrected for aerosol

West Coast
not corrected
for aerosol

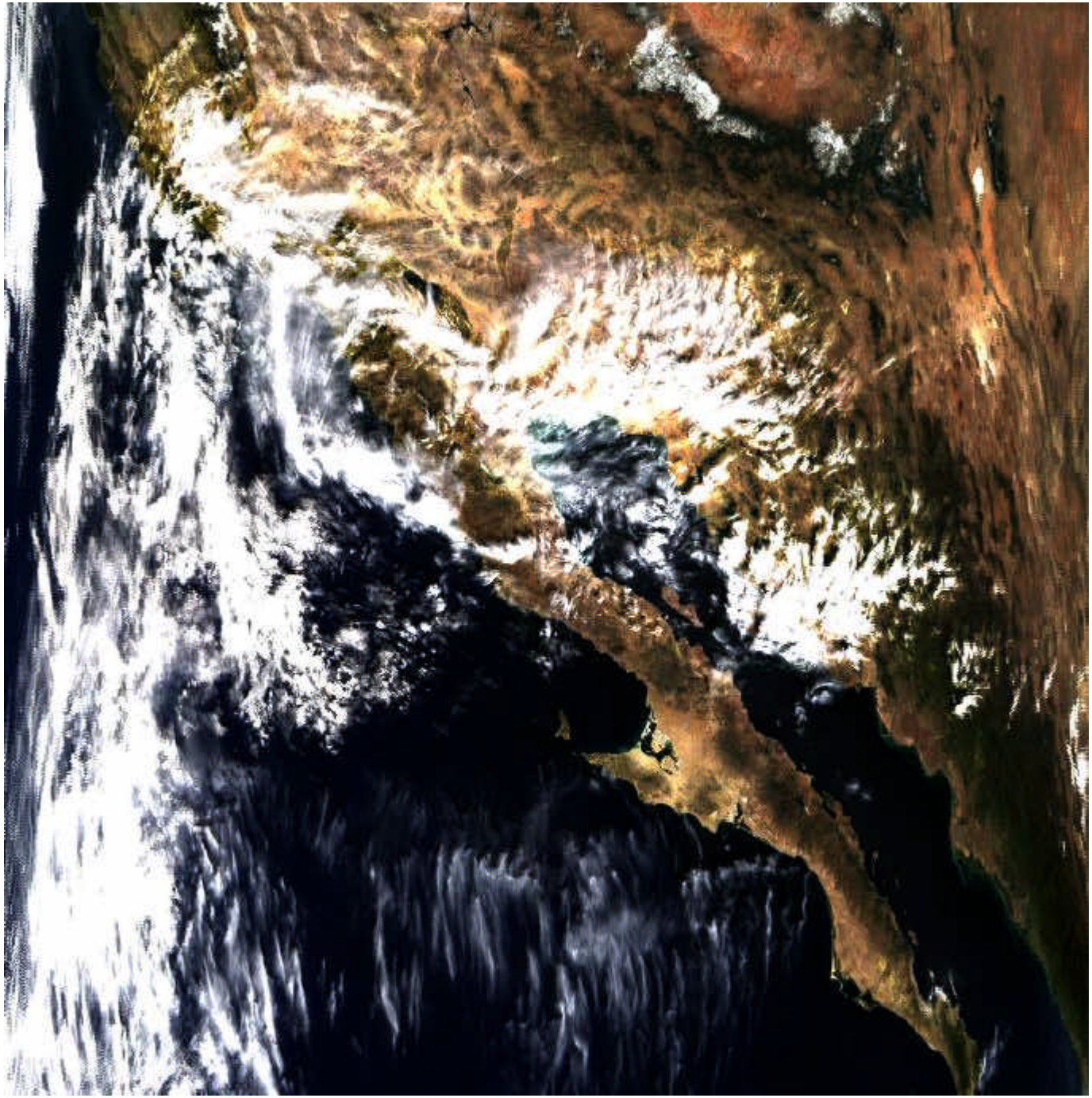


Corrected for aerosol, production algorithm

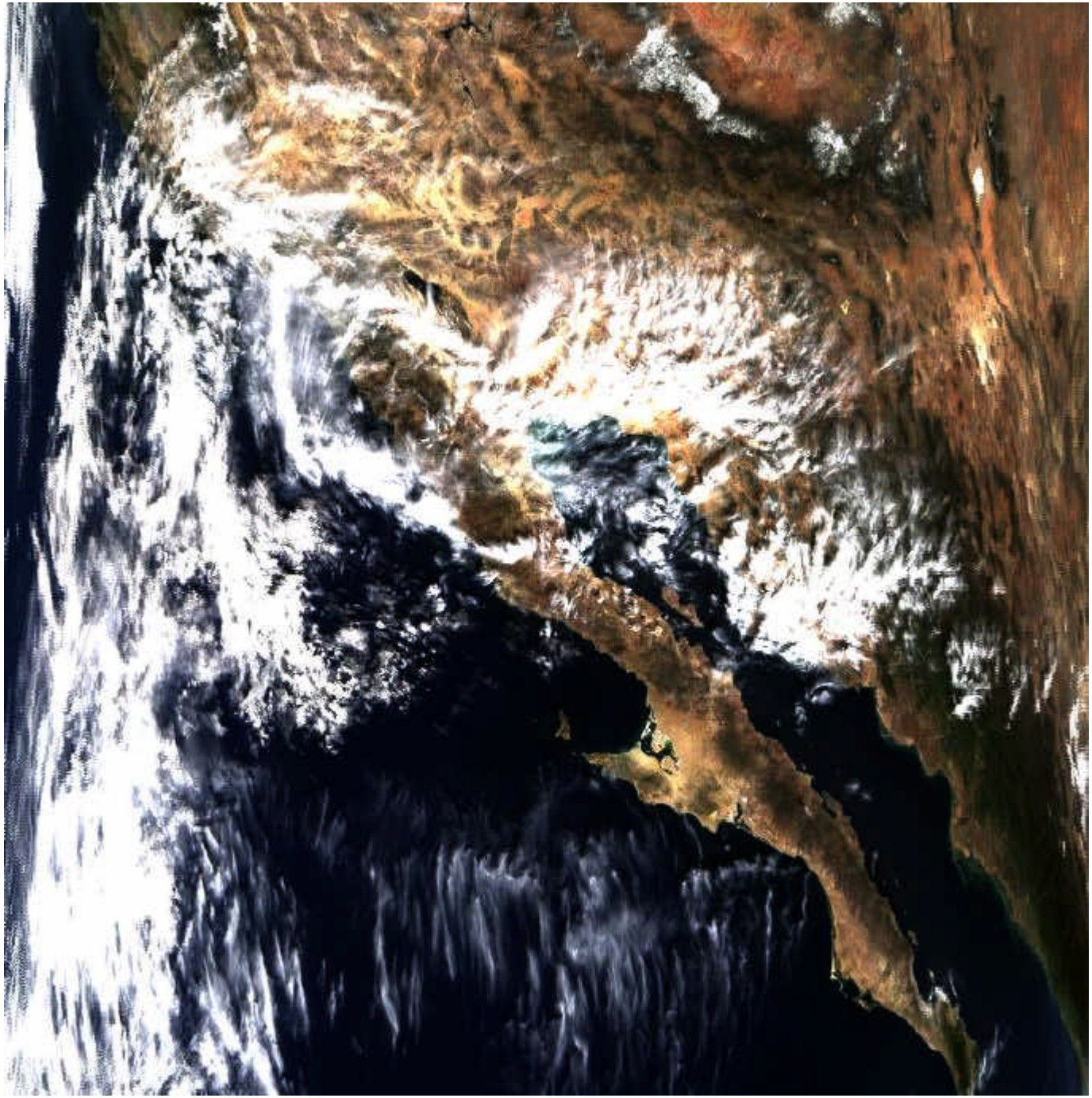




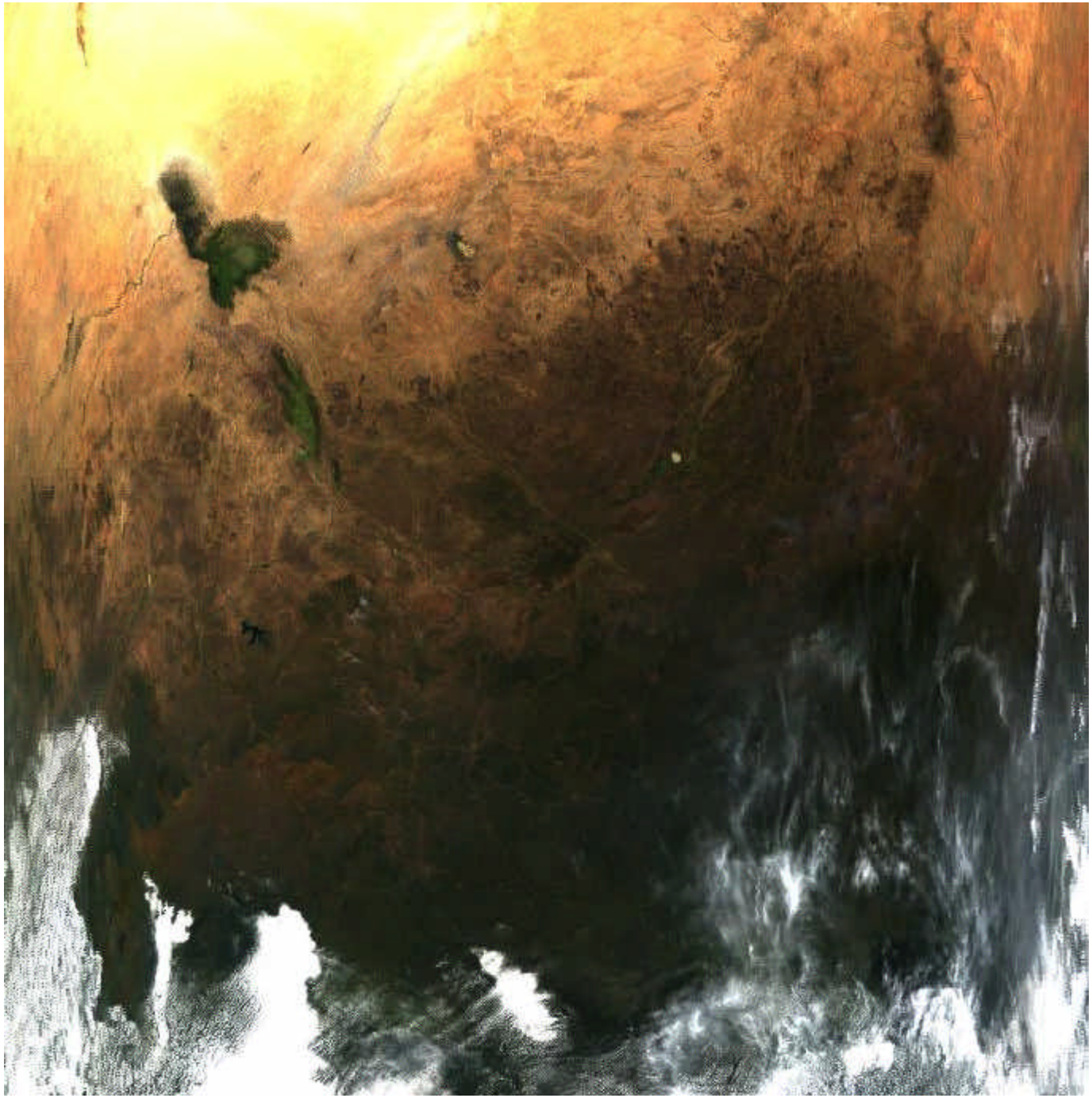
Corrected for aerosol, new algorithm



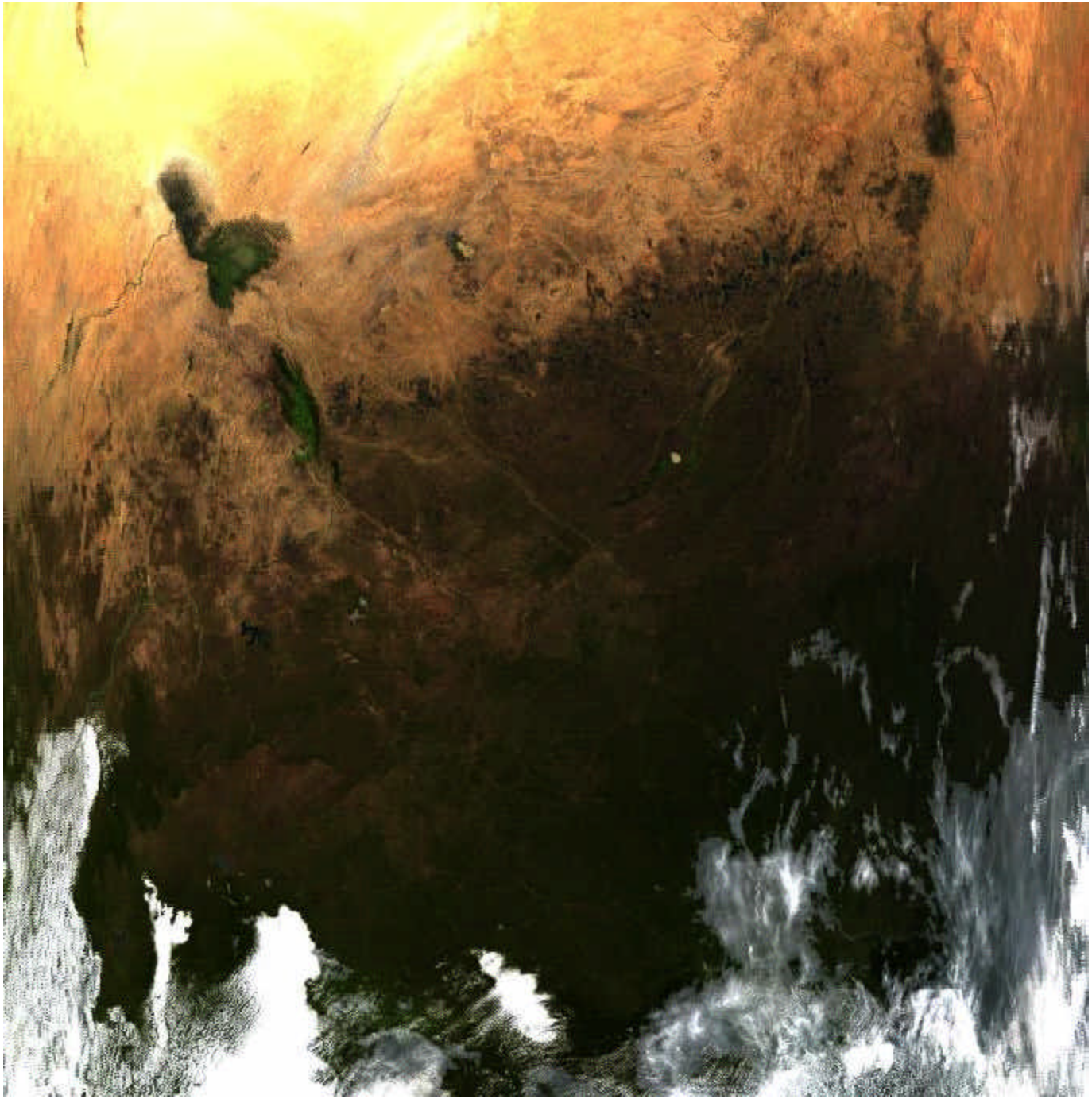
West Coast
not corrected
for aerosol



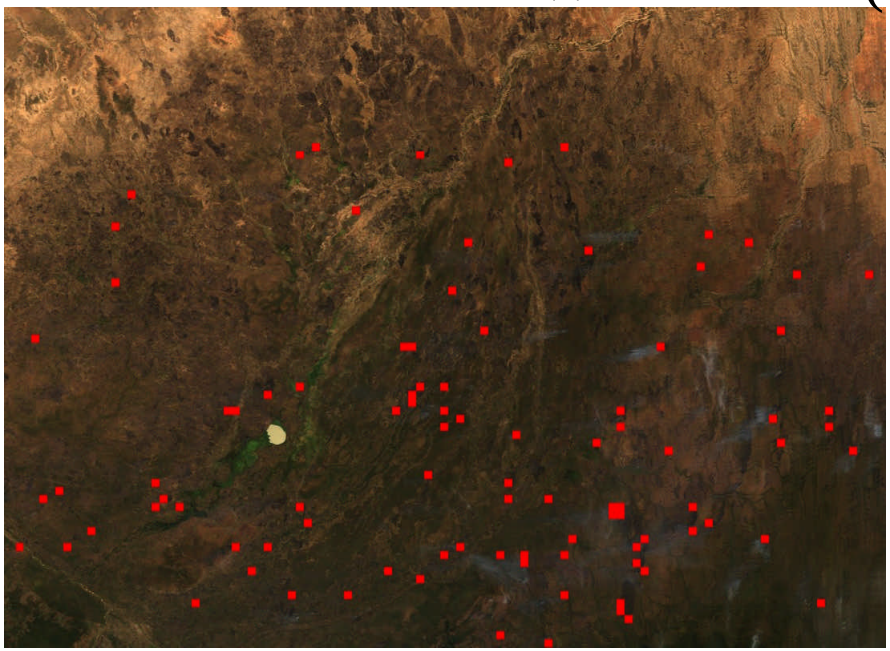
West Africa
(Lake Tchad)
not corrected
for aerosol



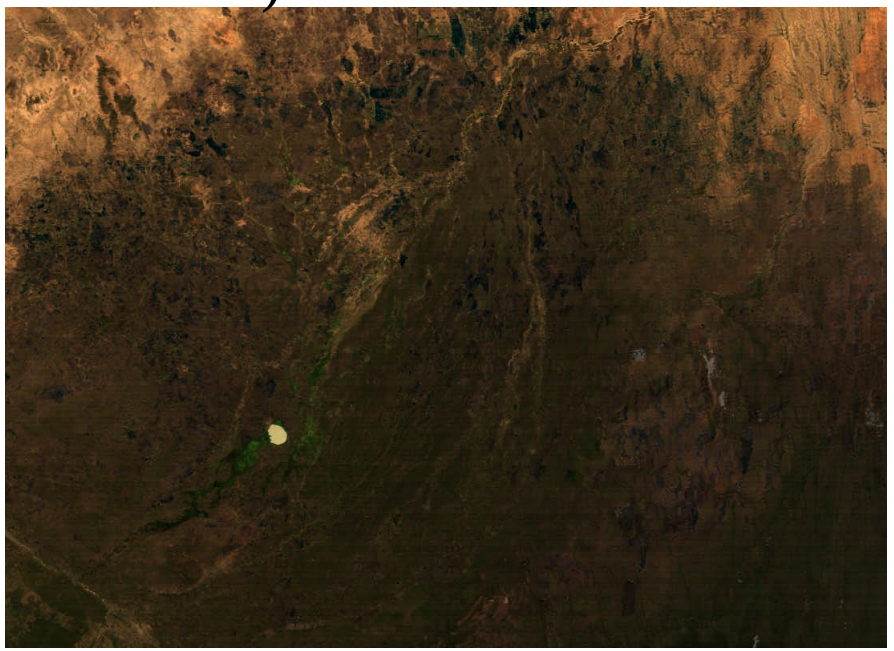
West Africa
(Lake Tchad)
corrected
for aerosol



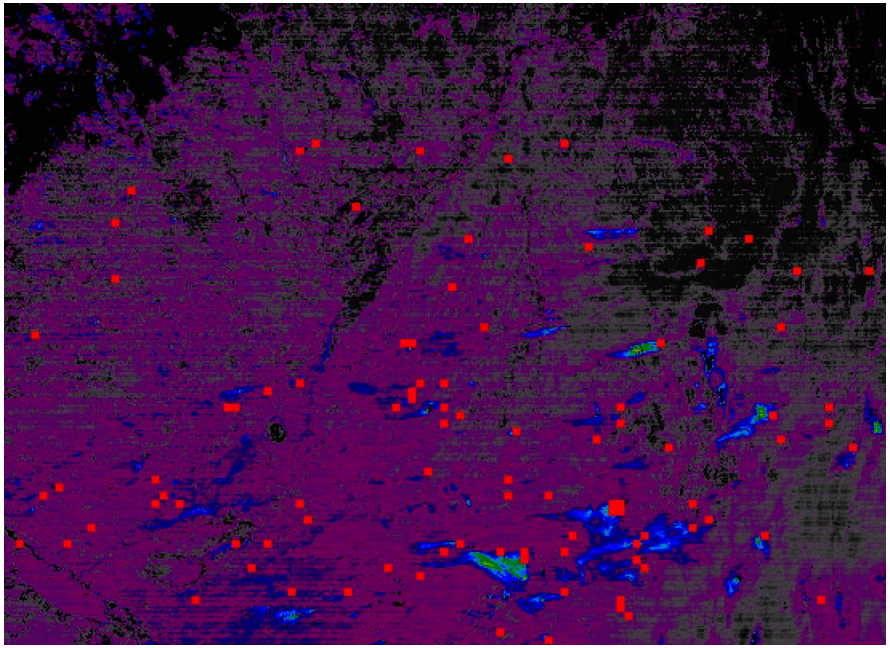
West Africa (Lake Tchad) details



Corrected for aerosol
(Fires in Red)

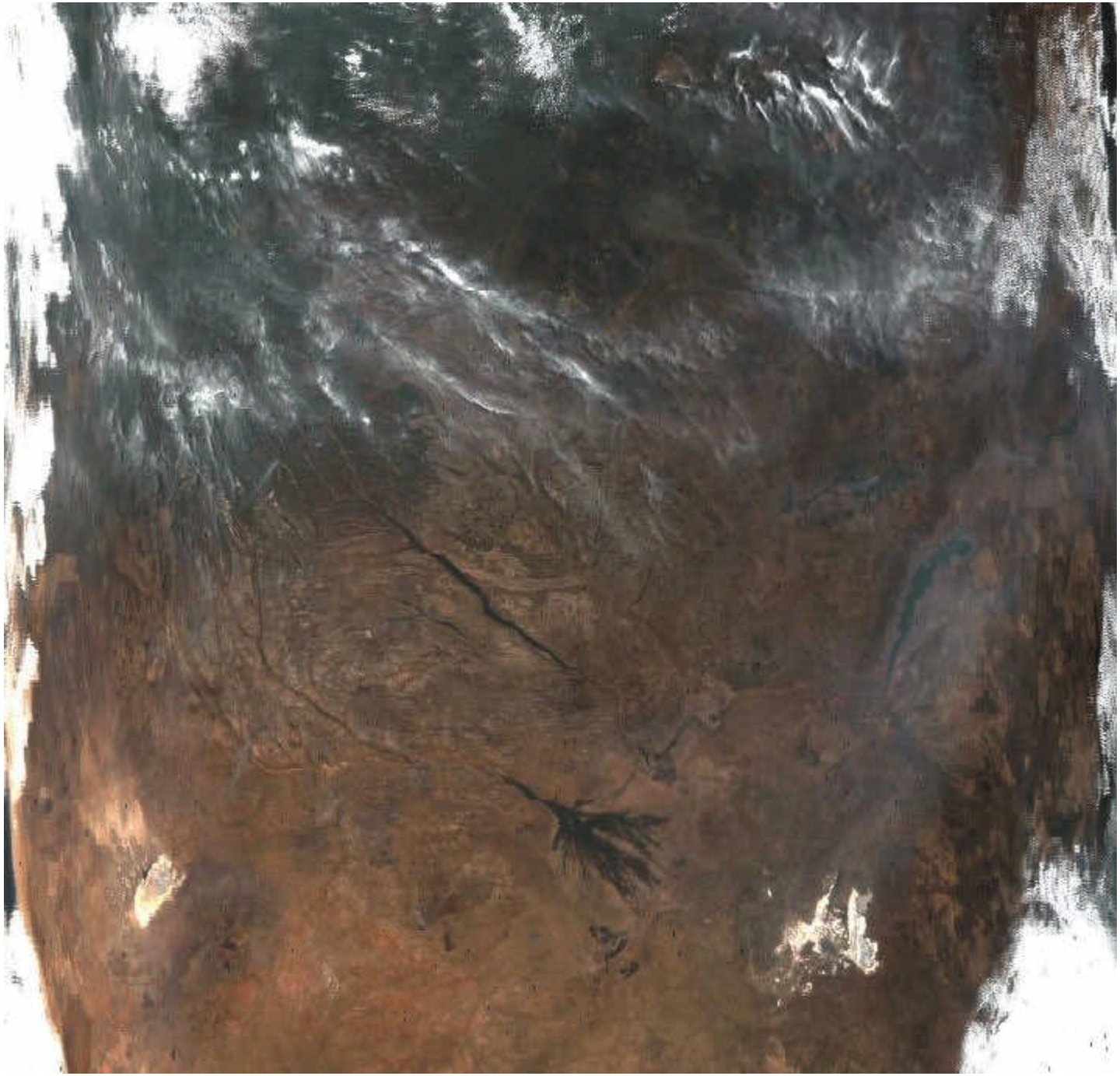


Corrected for aerosol

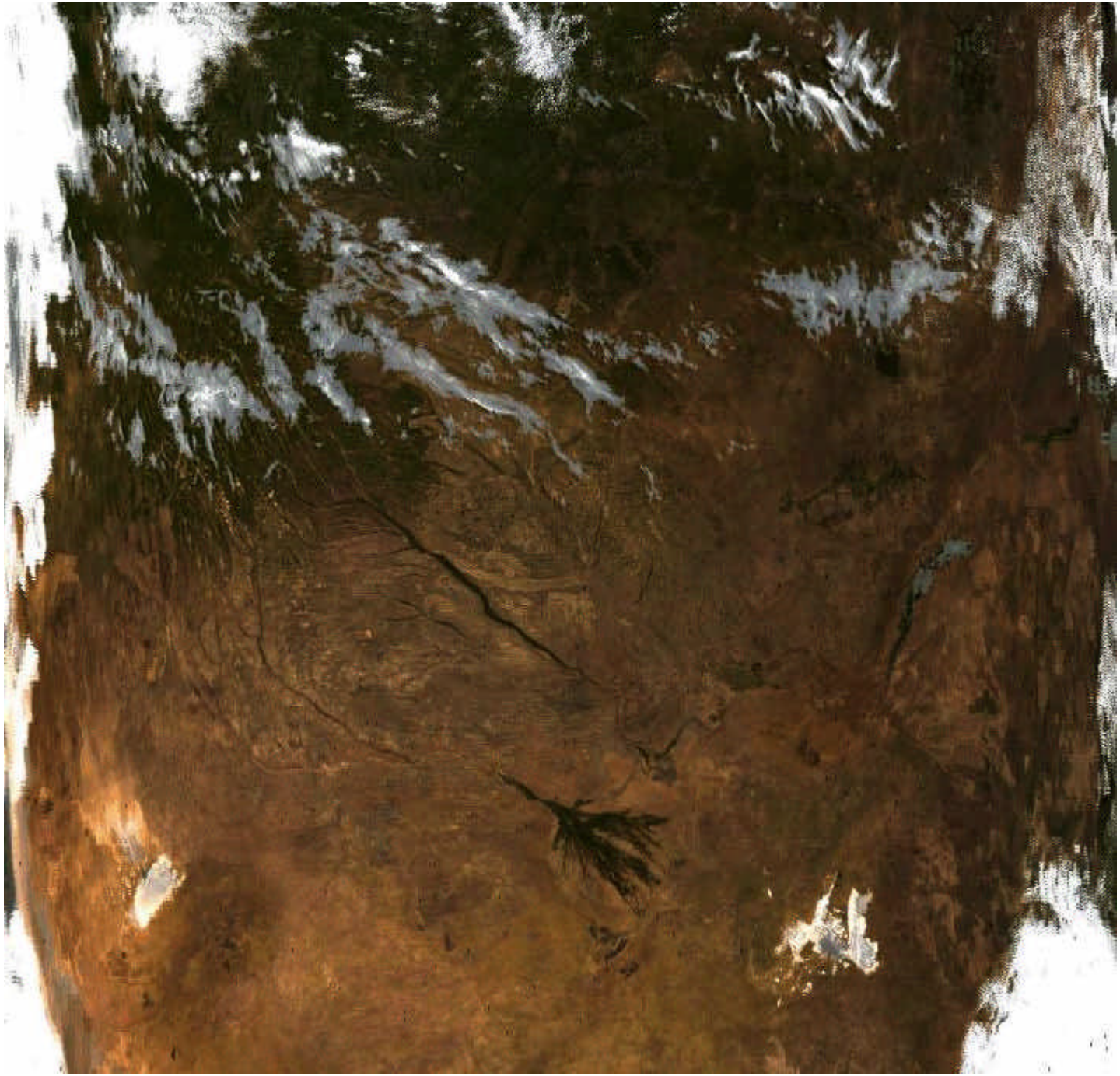


Aerosol optical depth 470nm
(Fires in Red)

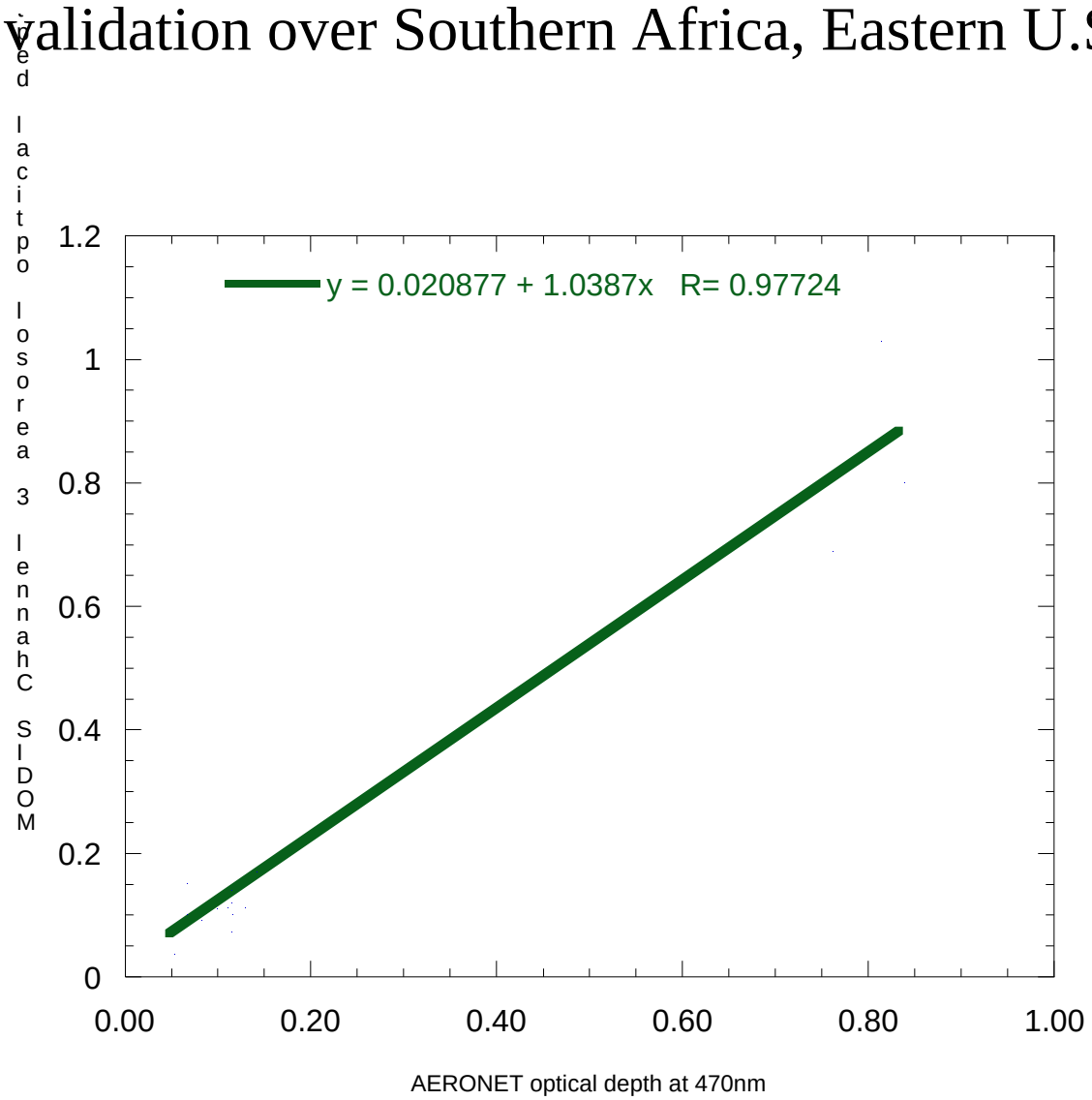
Southern Africa
not corrected
for aerosol



Southern Africa
corrected
for aerosol



Preliminary validation over Southern Africa, Eastern U.S.,West Coast

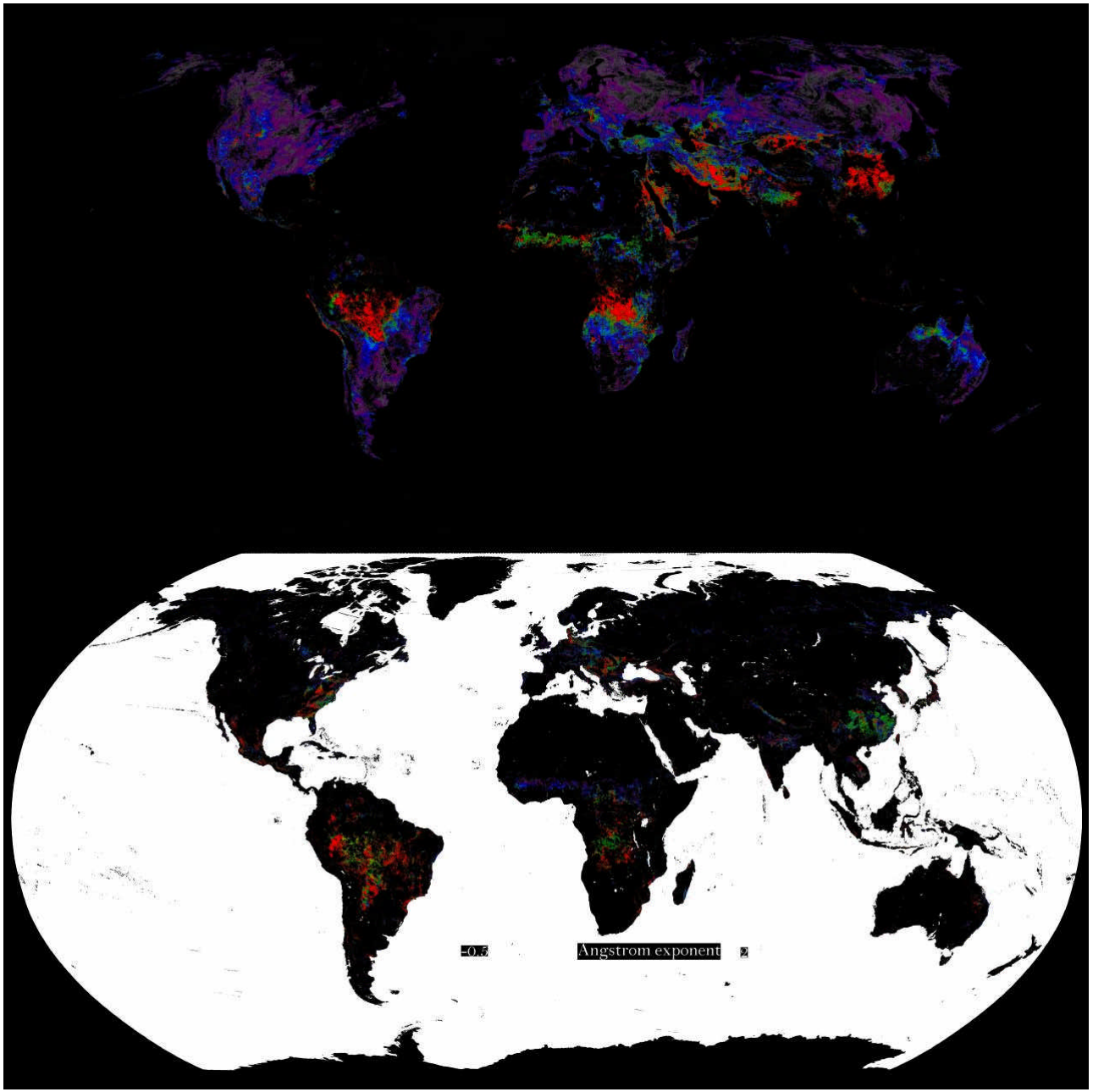


Application to global data set (coarse resolution)

Composite Period
265-272

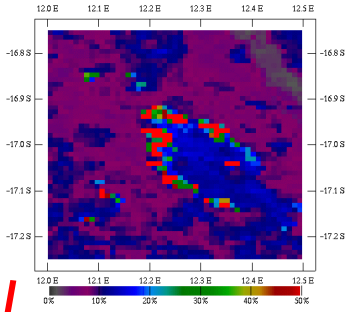
Aerosol optical depth at 470nm

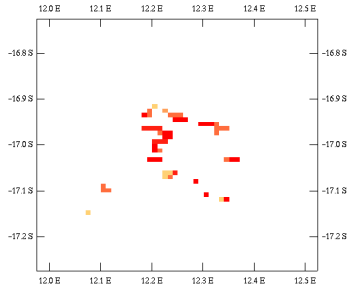
Angstrom exponent



Surface Reflectance at 3.79 μm

Year 2000 Day 238 Hour 08:55



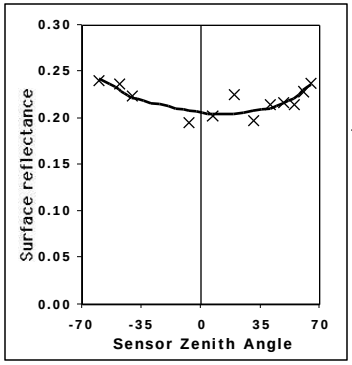


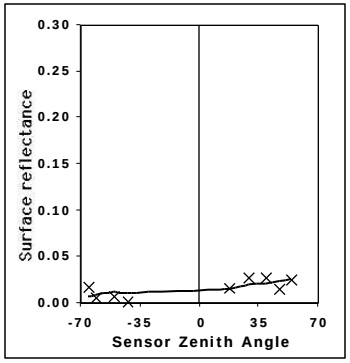
High Gain Detector Saturation

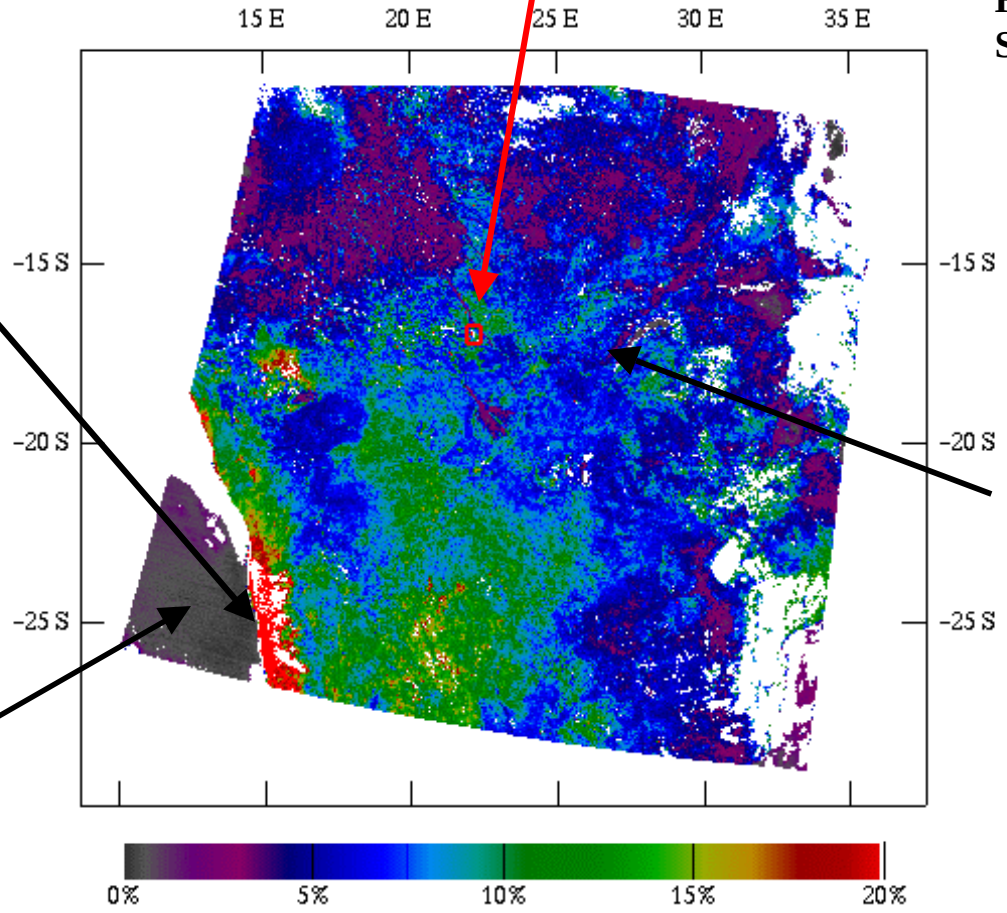
Active Fire

BRDF

Period 233-248

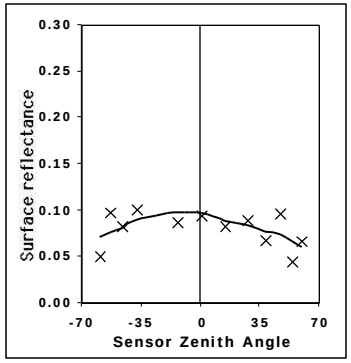






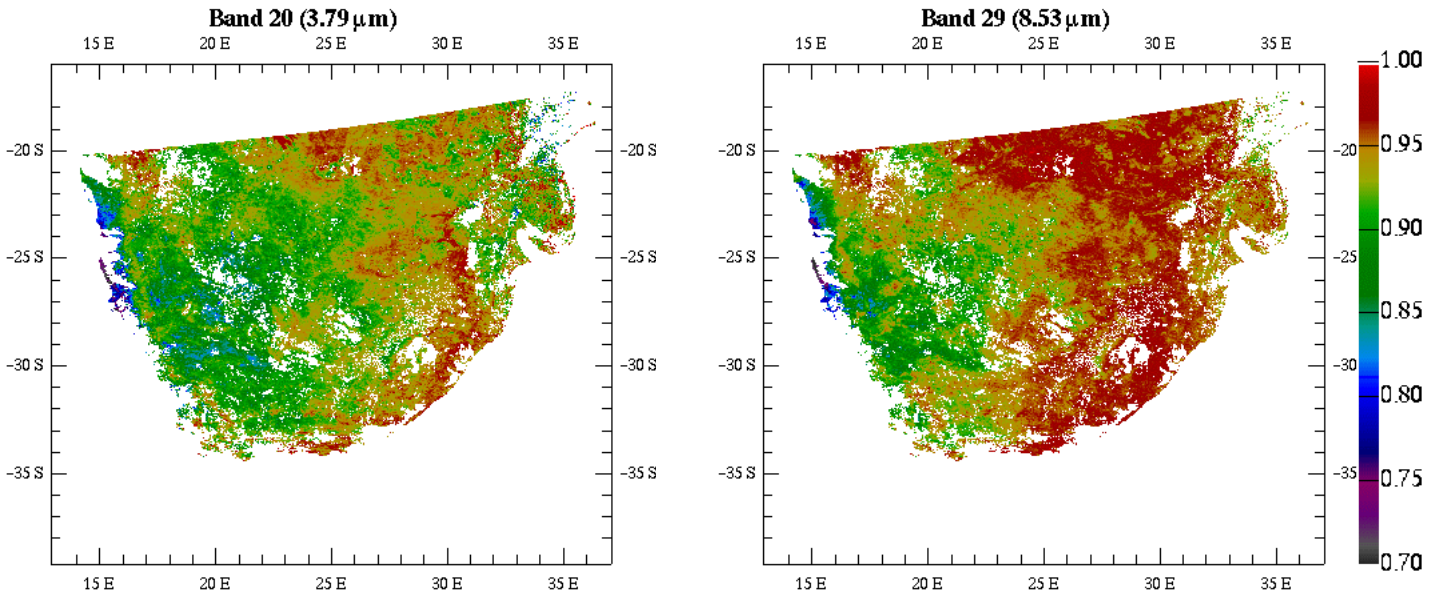
BRDF

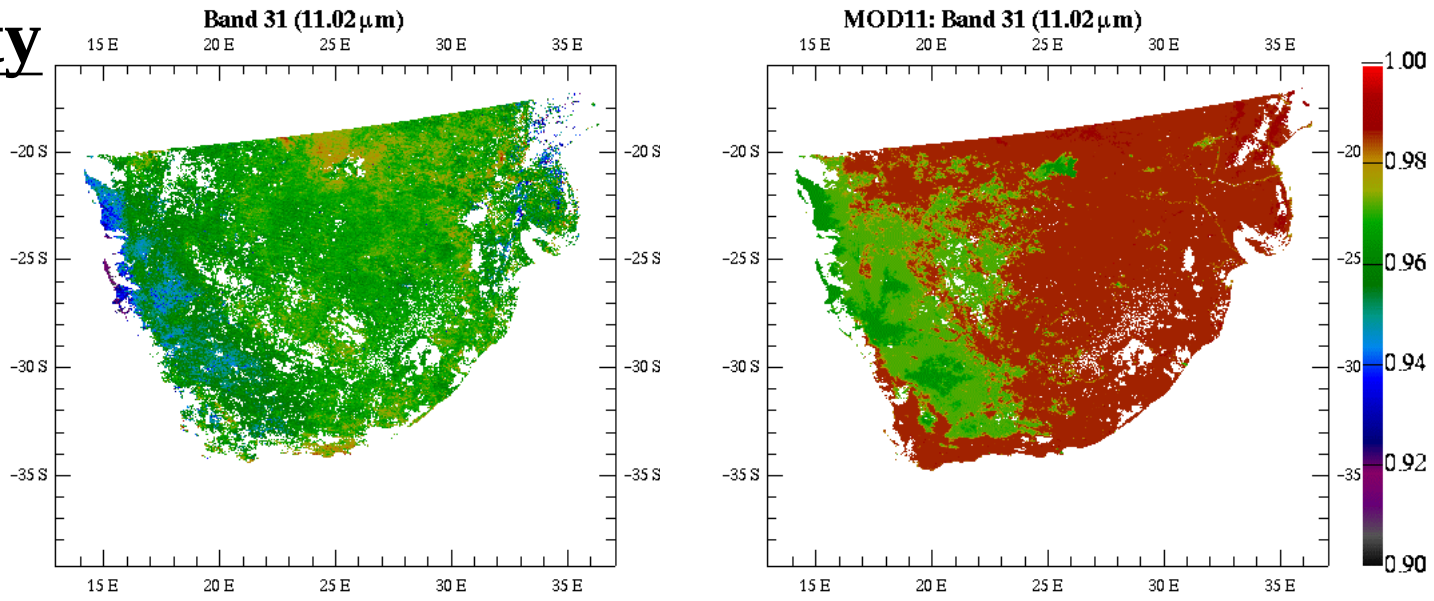
Period 233-248



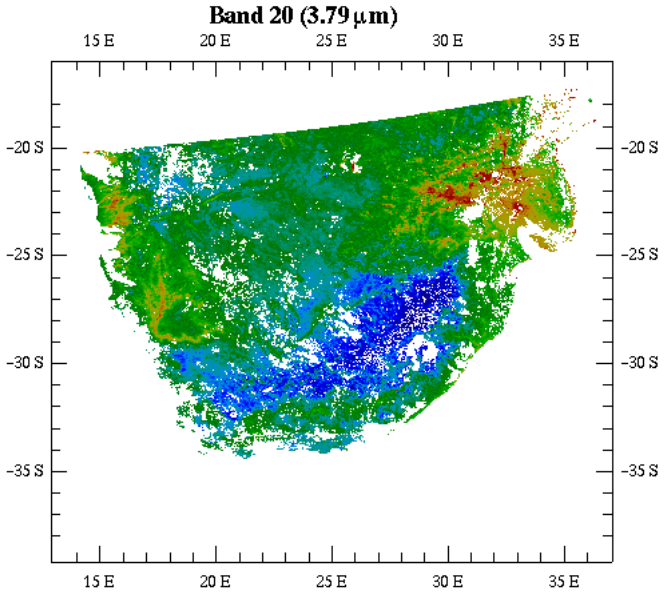
F. Petitcolin UMD dept. of Geography, January 2001

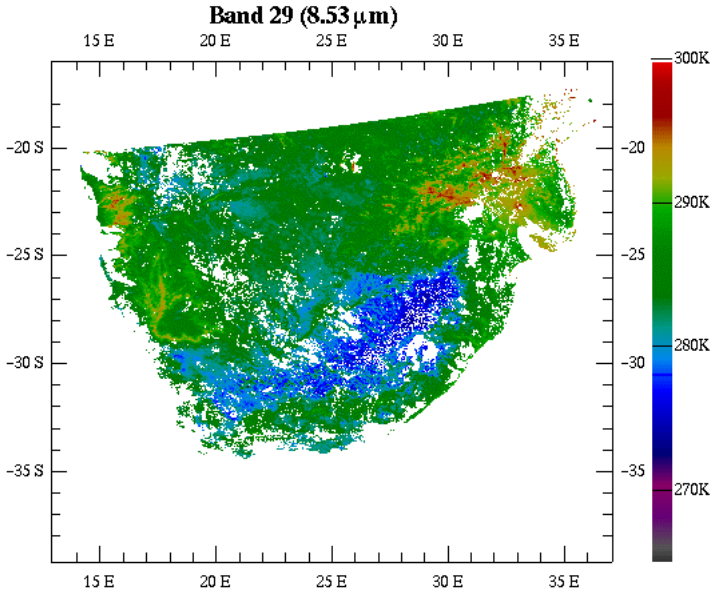
Spectral Emissivity

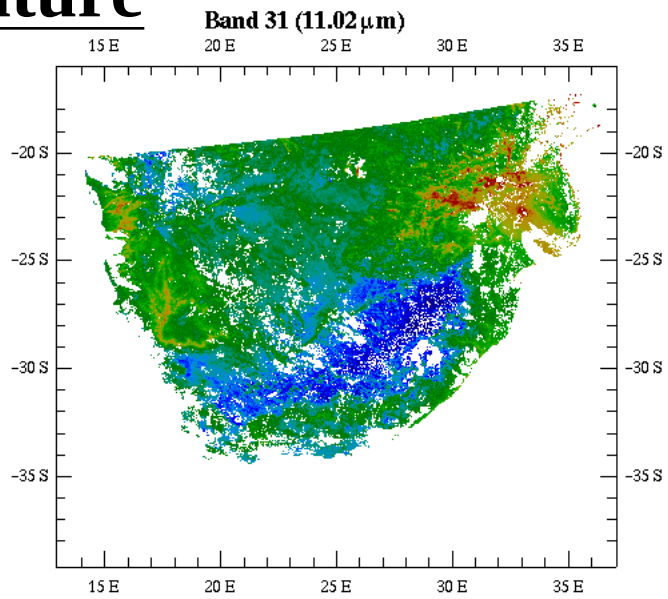


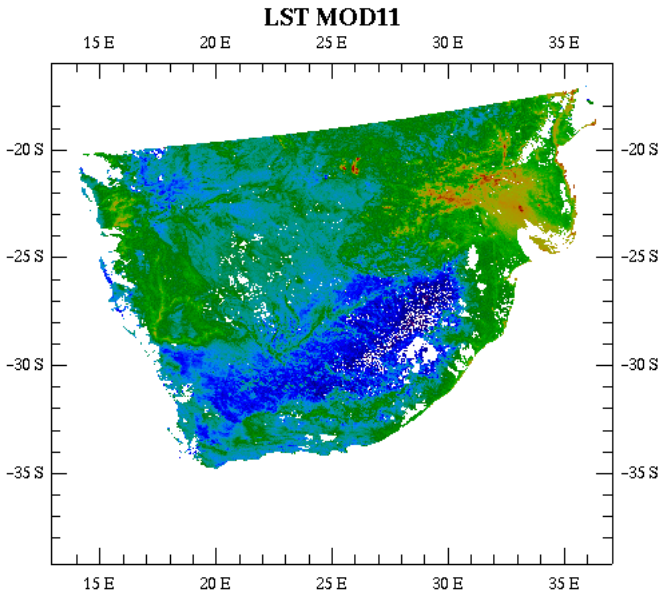


Land Surface Temperature

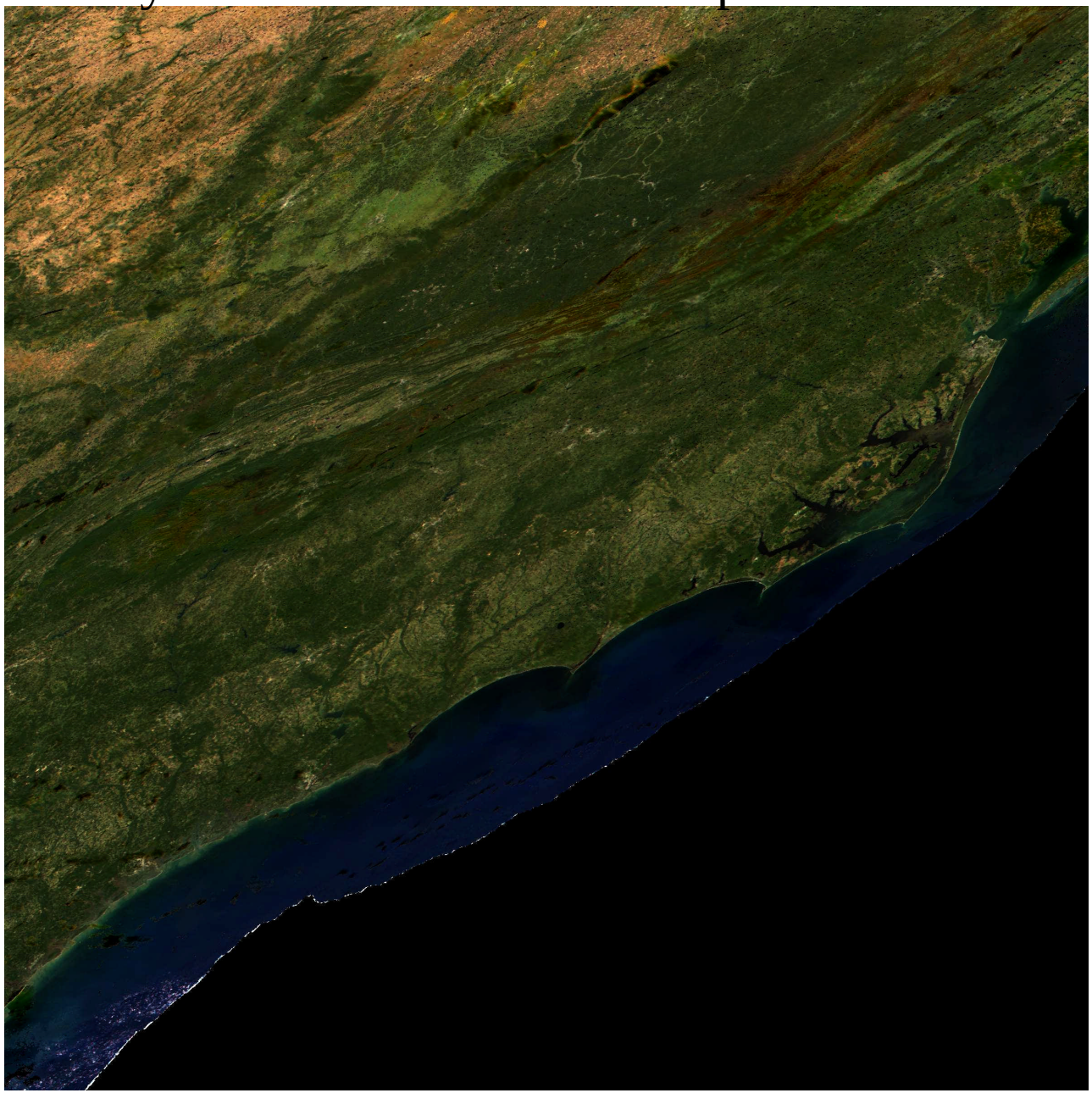






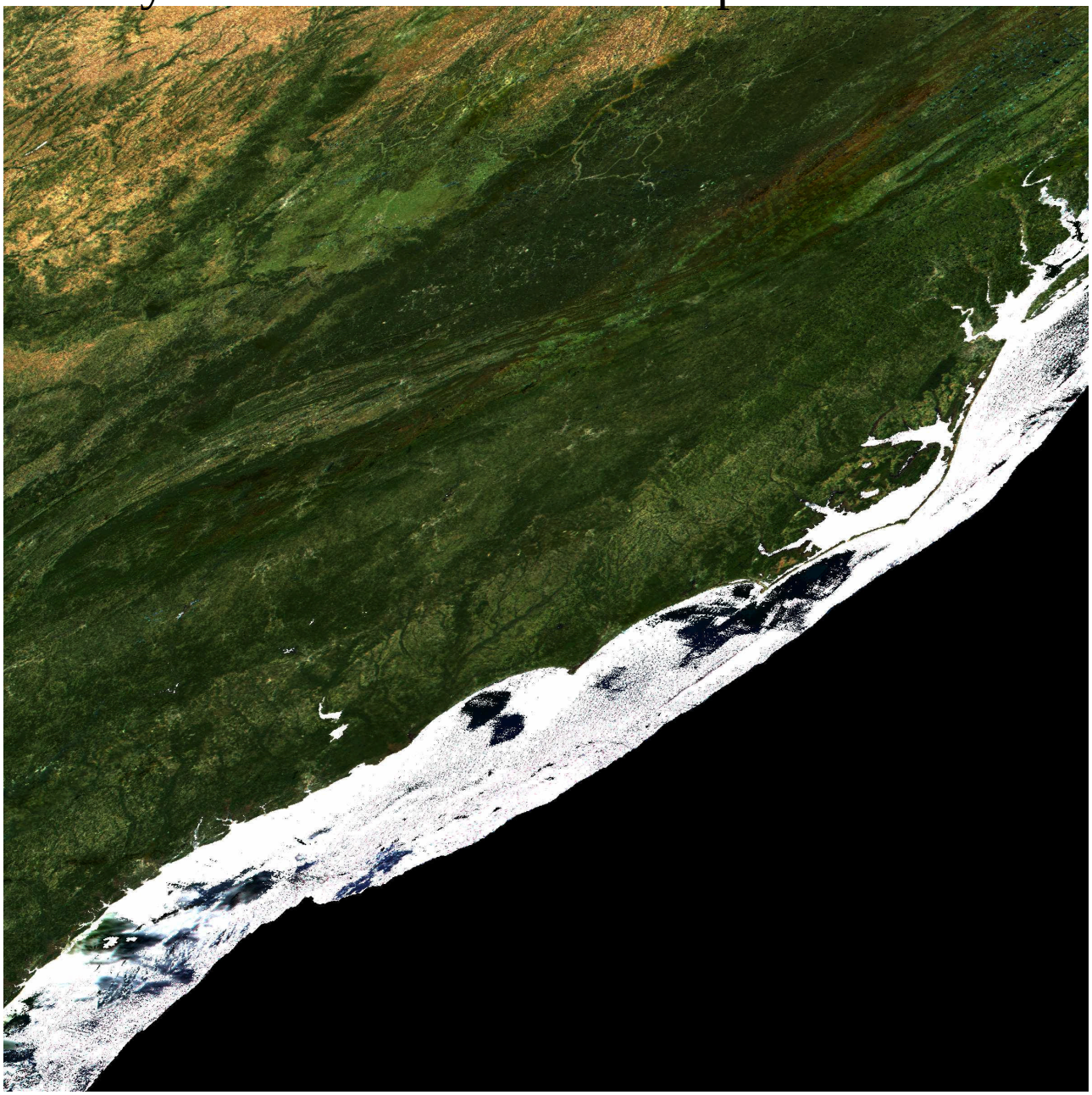


8 days surface reflectance composite



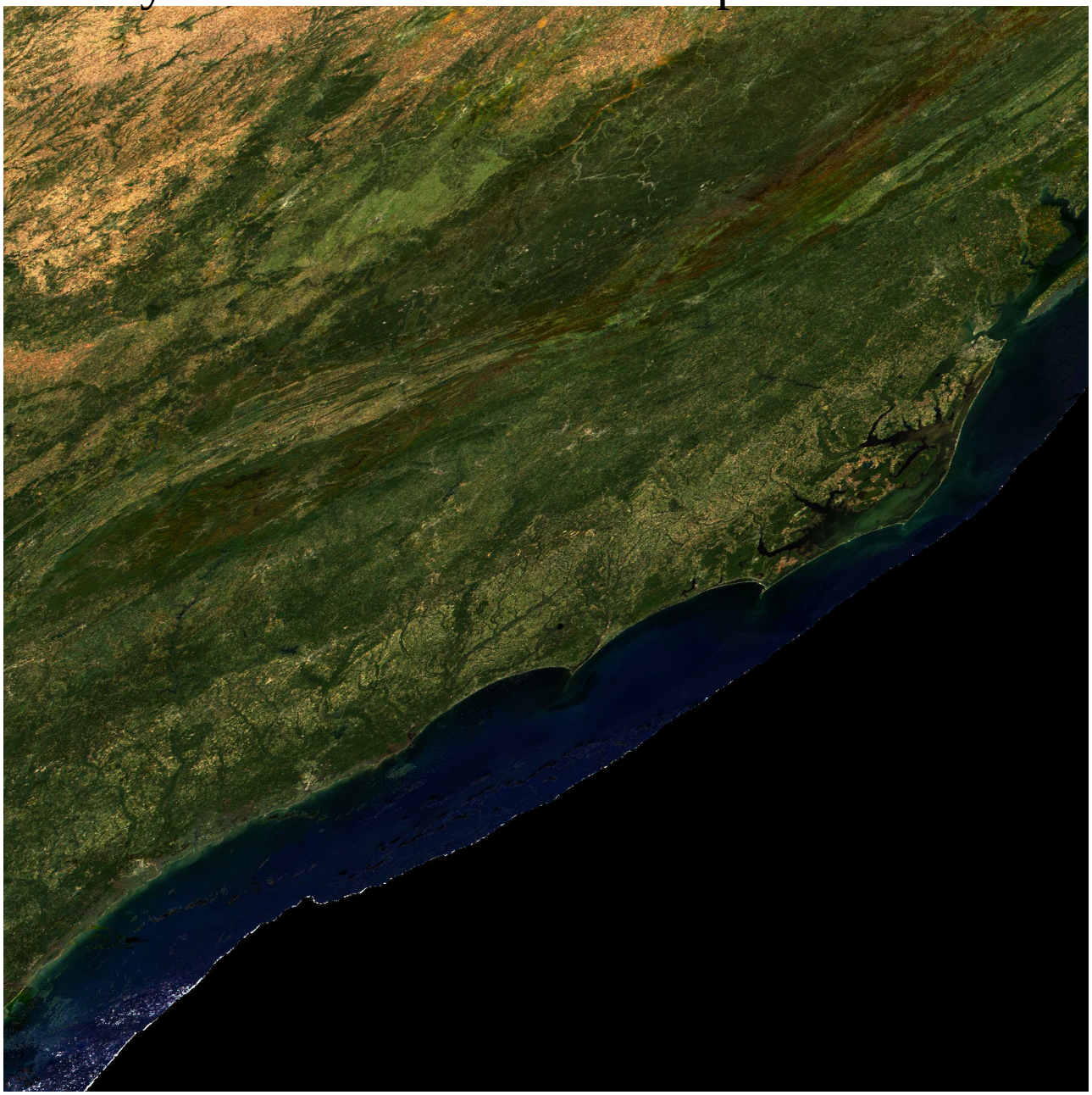
Minimum Blue (production algorithm)

8 days surface reflectance composite



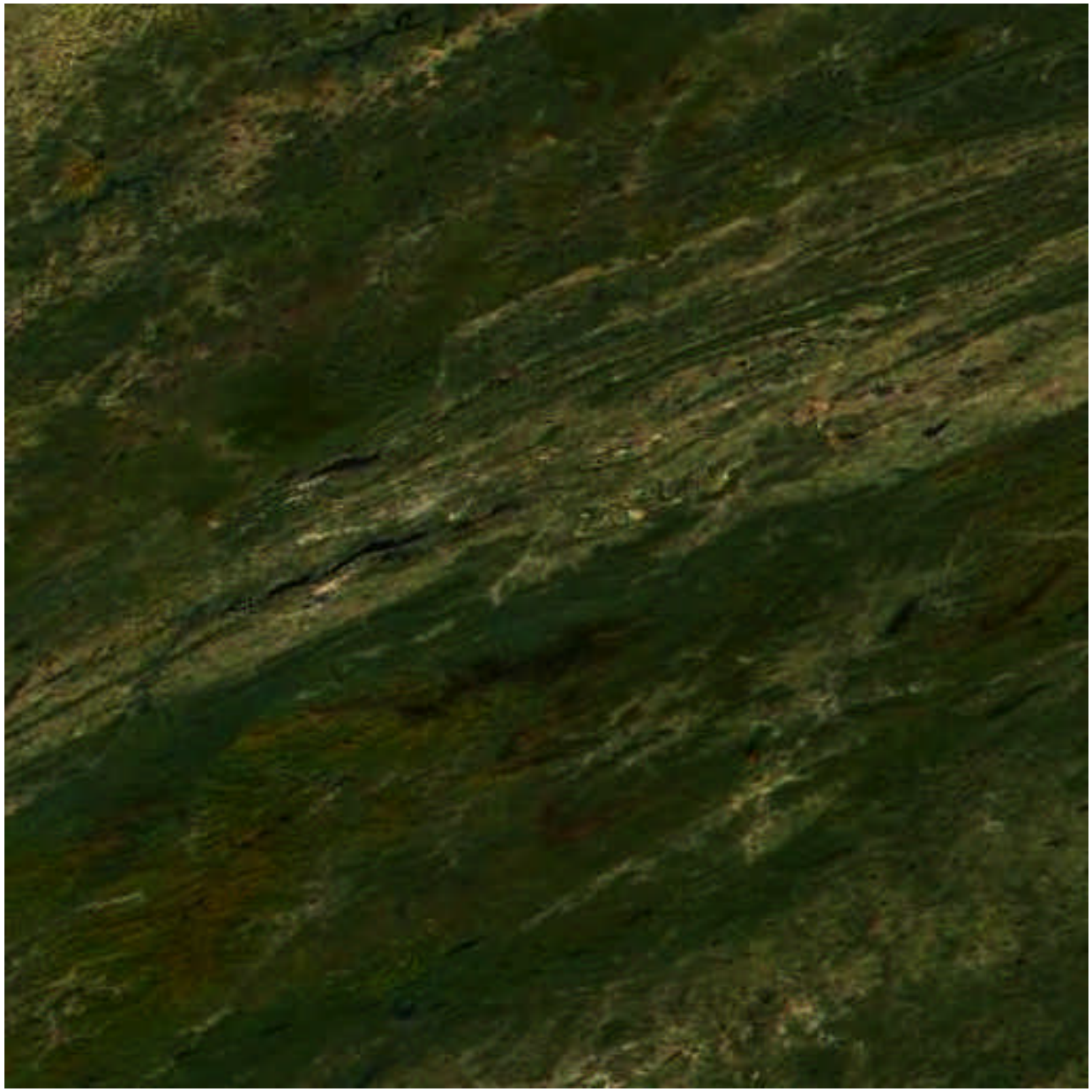
Maximum NDVI

8 days surface reflectance composite



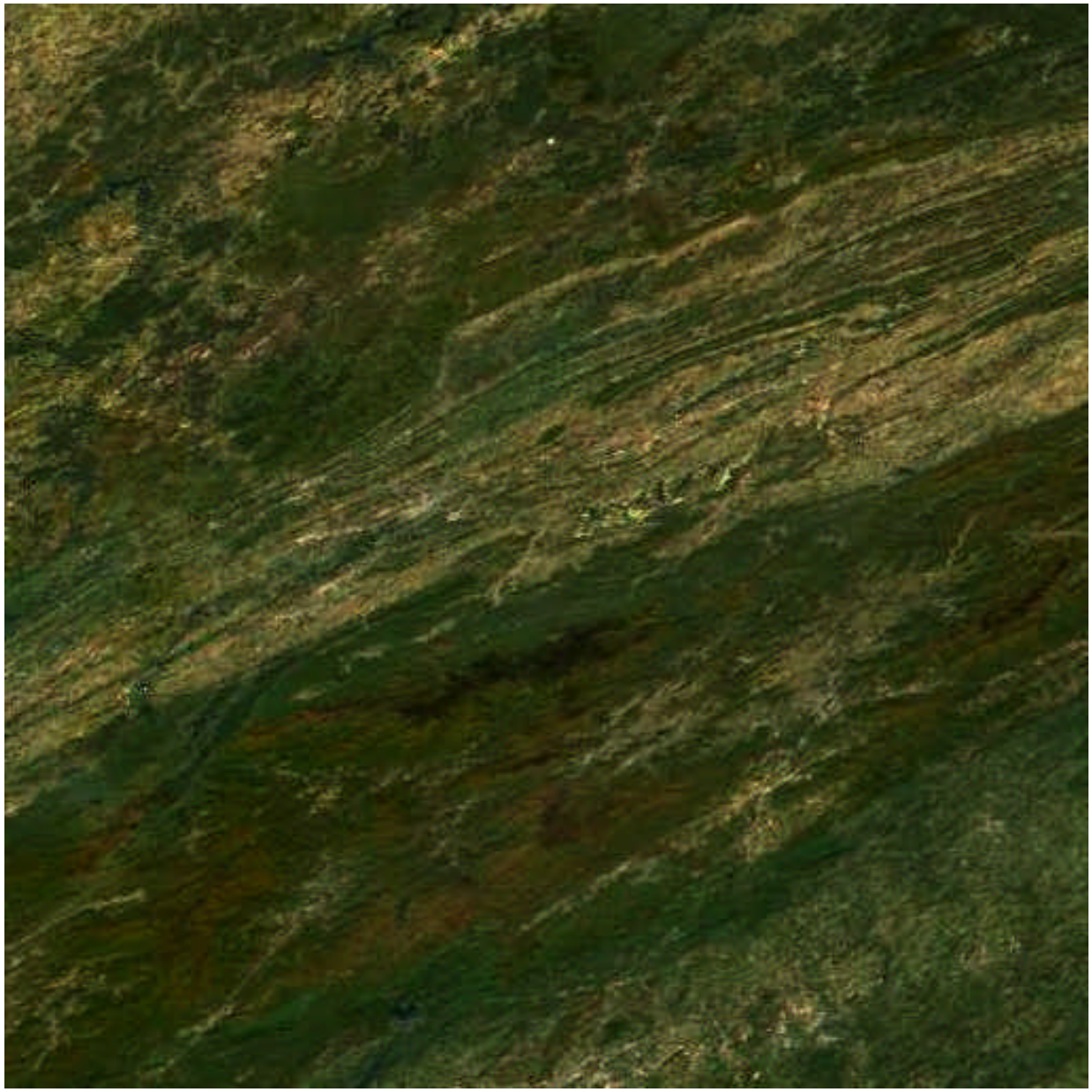
New algorithm (Min Blue+shadow filter+min view angle)

8 days surface reflectance composite (detail)



Production algorithm

8 days surface reflectance composite (detail)



New algorithm

8 days surface reflectance composite (detail)

Production algorithm

8 days surface reflectance composite (detail)

New algorithm

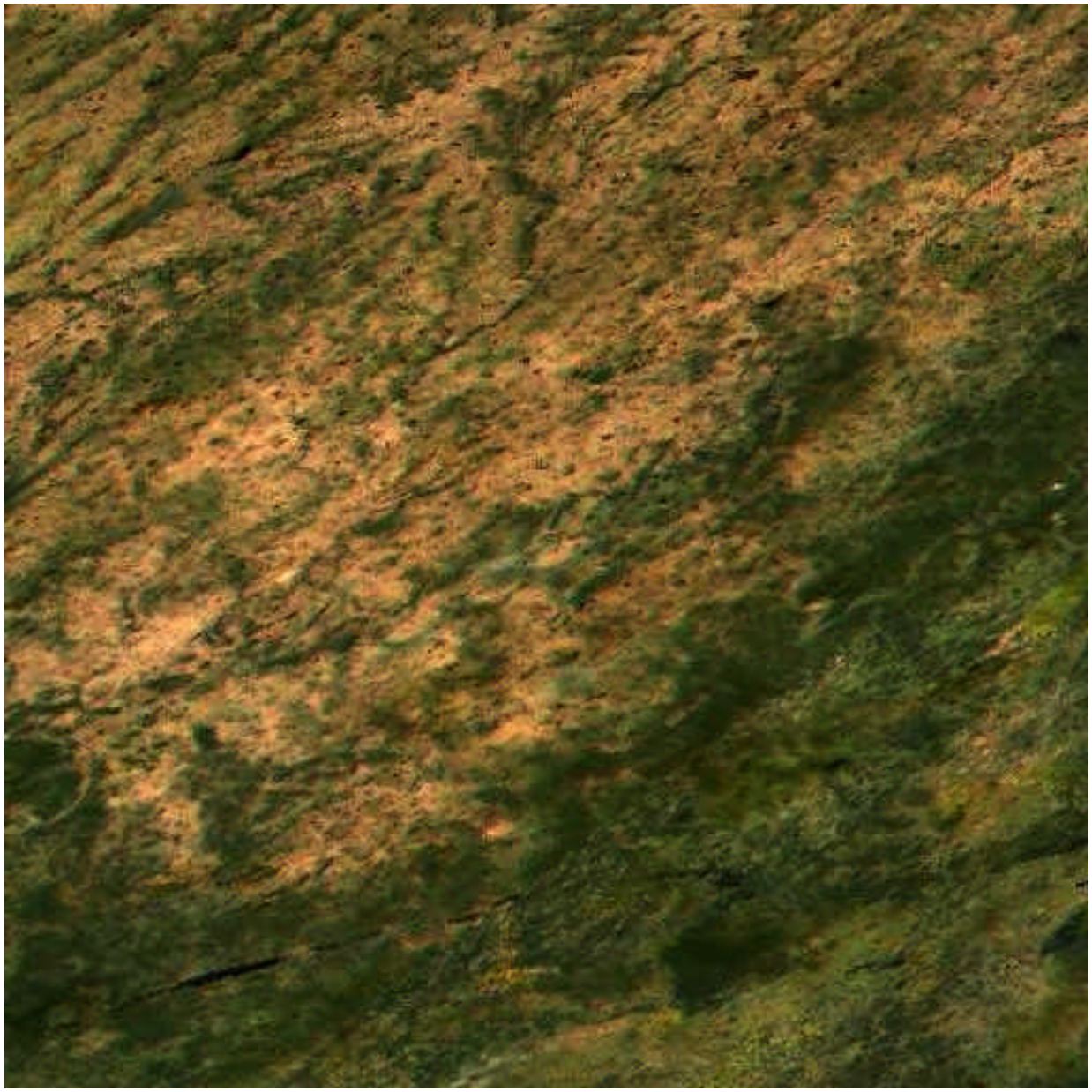
8 days surface reflectance composite (detail)

Production algorithm

8 days surface reflectance composite (detail)

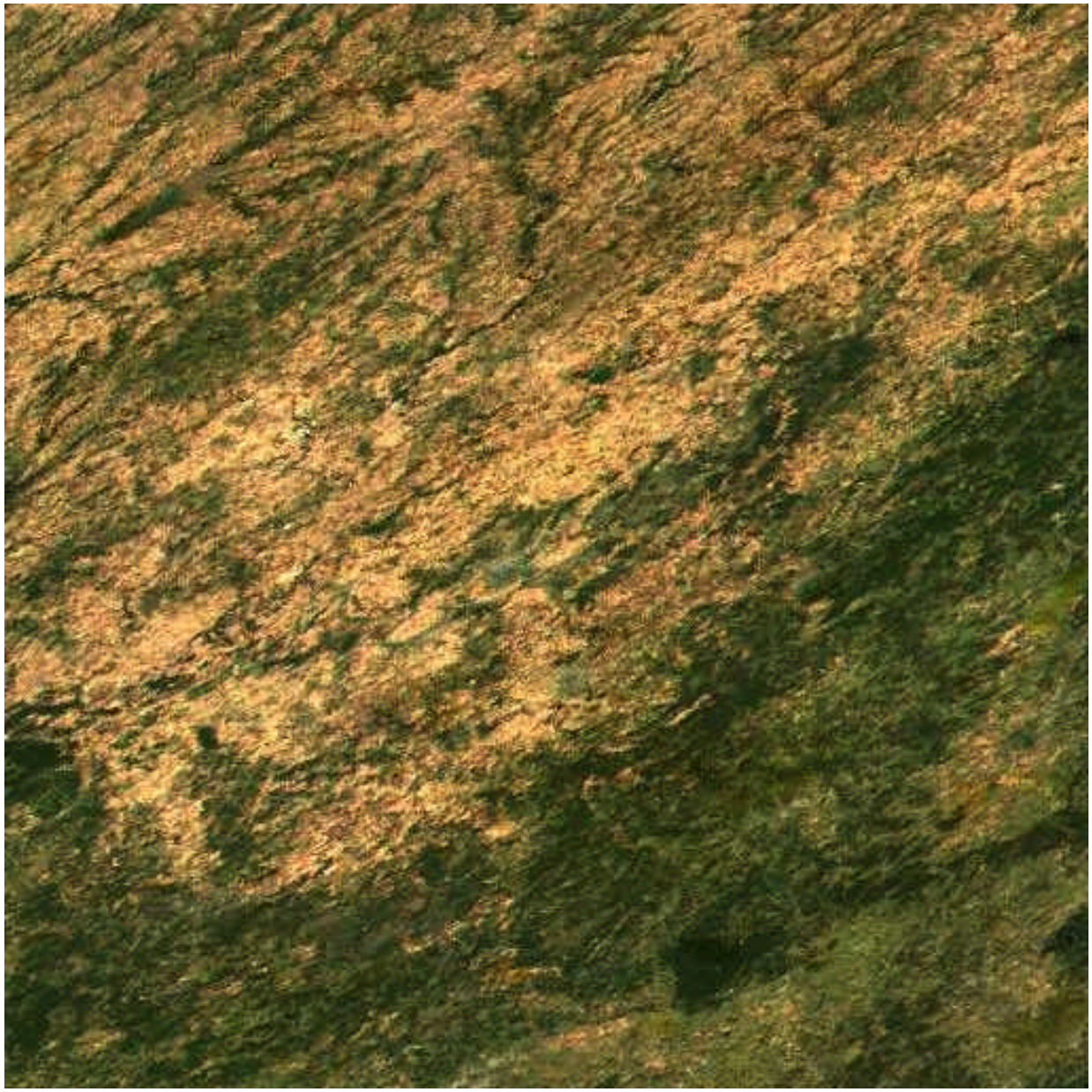
New algorithm

8 days surface reflectance composite (detail)



Production algorithm

8 days surface reflectance composite (detail)



New algorithm

Summary

- Significant advances being made in surface reflectance product
  - improved aerosol retrieval and extended to bright targets
  - composite products for monitoring change
- Critical foundation for improved biophysical parameters (e.g. VI, LAI/FPAR, BRDF)
- 3.75 reflectance and emissivity- experimental product
  - potential to improve the aerosol algorithm
  - potential improvements to LST
  - fire / burn scar detection and characterization
- Planned areas for investigation
  - instrument performance re. product quality/calibration
  - adjacency (inc. aerosol) and BRDF coupling
  - cirrus correction, aerosol refinement
  - product accuracy

MODIS BRDF/Albedo Product (MOD43B)

PIs: Alan Strahler[1], Jan-Peter Muller[5]

Development and Validation Team: Crystal Schaaf[1], Feng Gao[1,2], Wolfgang Lucht[3], Trevor Tsang[1], Nicholas Strugnell[1], Xiaowen Li[1,4], Xiaoyang Zhang[1], Yufang Jin[1], Doug McIver[1], Philip Lewis[6], Michael Barnsley[7], Paul Hobson[7], Mathias Disney[6], Gareth Roberts[6], Michael Dunderdale[5], Christopher Doll[5], Shunlin Liang[8], and Jeff Privette[9]

1 Center for Remote Sensing, Boston University, 725 Commonwealth Avenue, Boston, MA 02215, USA
Tel. +617-358-0503, Fax +617-353-3200, e-mail: alan@bu.edu, schaaf@bu.edu.
2 Nanjing Institute of Geography and Limnology, Chinese Academy of Sciences, Nanjing, China
3 Potsdam-Institut f r Klimafolgenforschung, Postfach 601203, D-14412 Potsdam, Germany
4 Research Center for Remote Sensing, Beijing Normal University, Beijing, China
5 Depart. of Geomatic Engineering, University College London, Gower St., London, WCIE 6BT, UK
6 Department of Geography, University College London, Gower St., London, WCIE 6BT, UK
7 Department of Geography, University of Wales Swansea, Singleton Park, Swansea, SA2 8PP, UK
8 Department of Geography, University of Maryland, College Park, MD 20742, USA
9 Biospheric Sciences, NASA Goddard Space Flight Center, Greenbelt MD , 20771, USA

The MODIS BRDF/Albedo Product provides global measures of albedo, surface reflectance and surface anisotropy every 16 days at a 1km gridded spatial resolution.

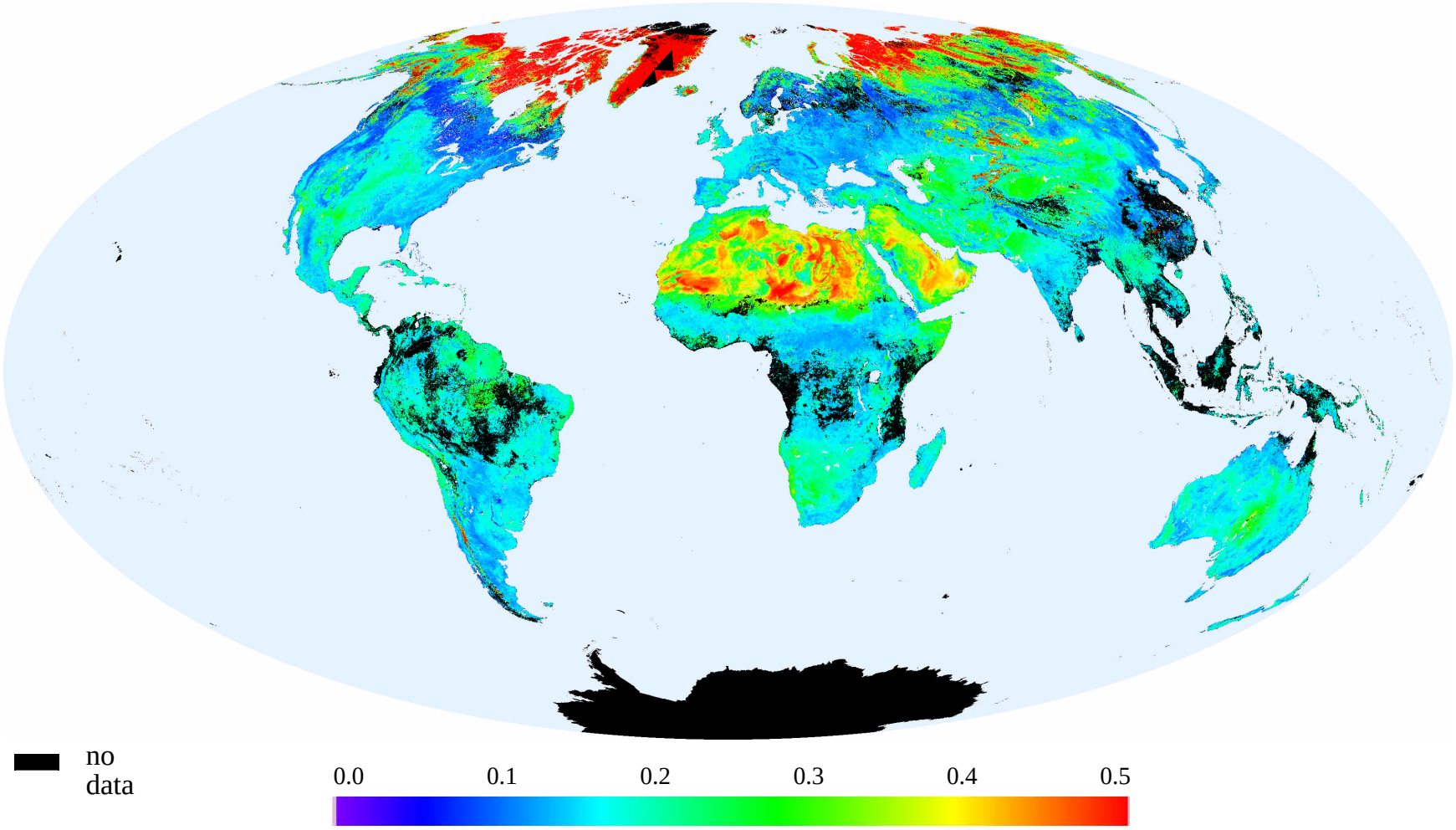
BRDF parameters are provided for global climate modelers wishing to completely describe the anisotropy of the surface boundary layer and to compute all albedo and surface reflectance measures at any desired view and illumination geometry.

Bihemispherical (white-sky) albedo and directional hemispherical (black-sky) albedos are directly computed for those modelers just requiring diffuse albedo or direct beam albedo at local solar noon. Actual albedos can be estimated by interpolating the white-sky and black-sky albedos as a function of diffuse skylight.

Nadir BRDF-adjusted Reflectances (NBAR) are provided for all users requiring surface reflectances that have not only been cloud-cleared and atmospherically corrected but have also been corrected to a common nadir viewing geometry.

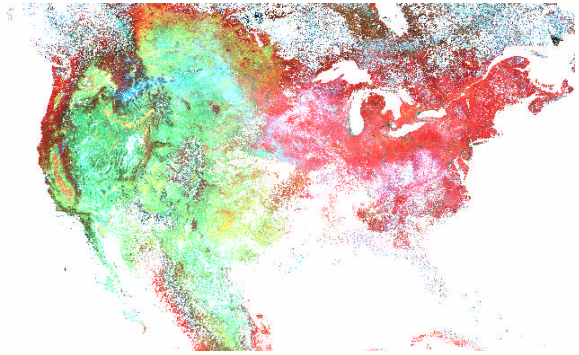
Global Broadband White-Sky Albedo (0.3-5.0µm)

Sept. 29 - Oct. 30, 2000

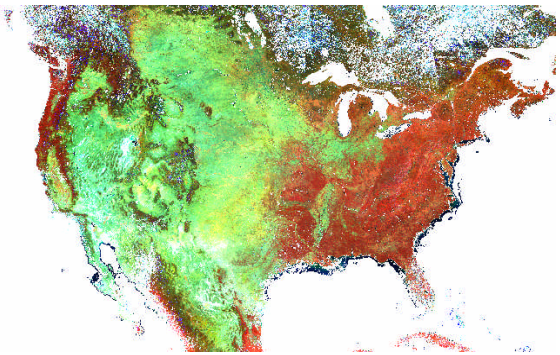


10 km resolution, Hammer-Aitoff
projection,
produced by MODIS BRDF/Albedo Team

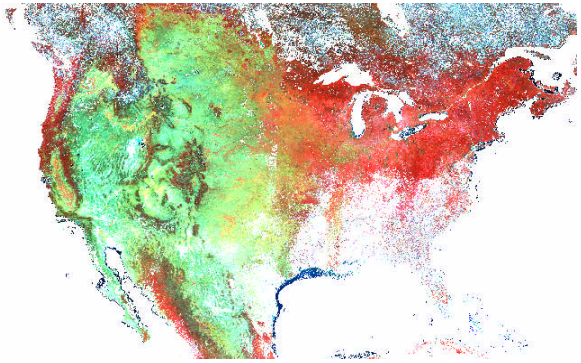
White-Sky Albedo



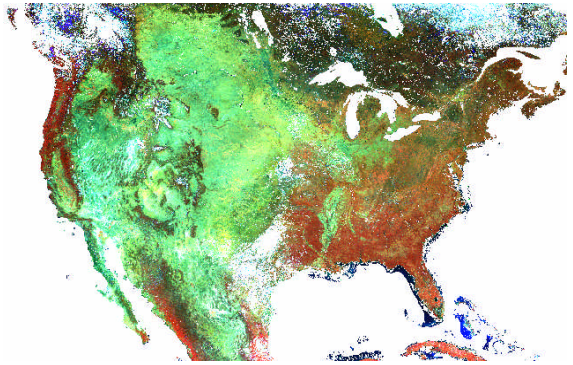
12-28 August, 2000 (Day 225)



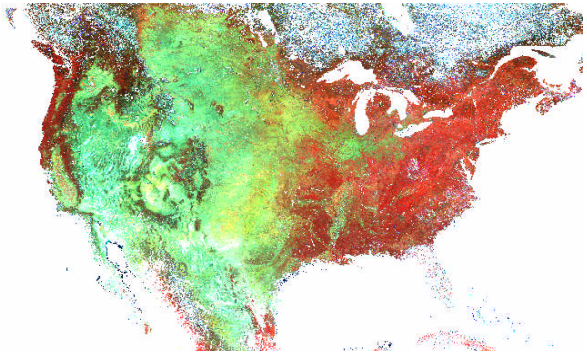
29 September - 14 October, 2000 (Day 273)



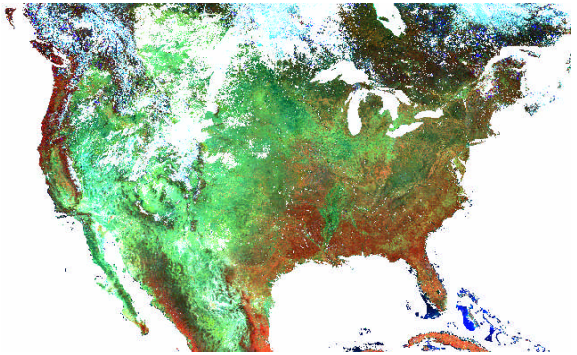
29 August - 12 September (Day 241)



15-30 October, 2000 (Day 289)



13-28 September, 2000 (Day 257)

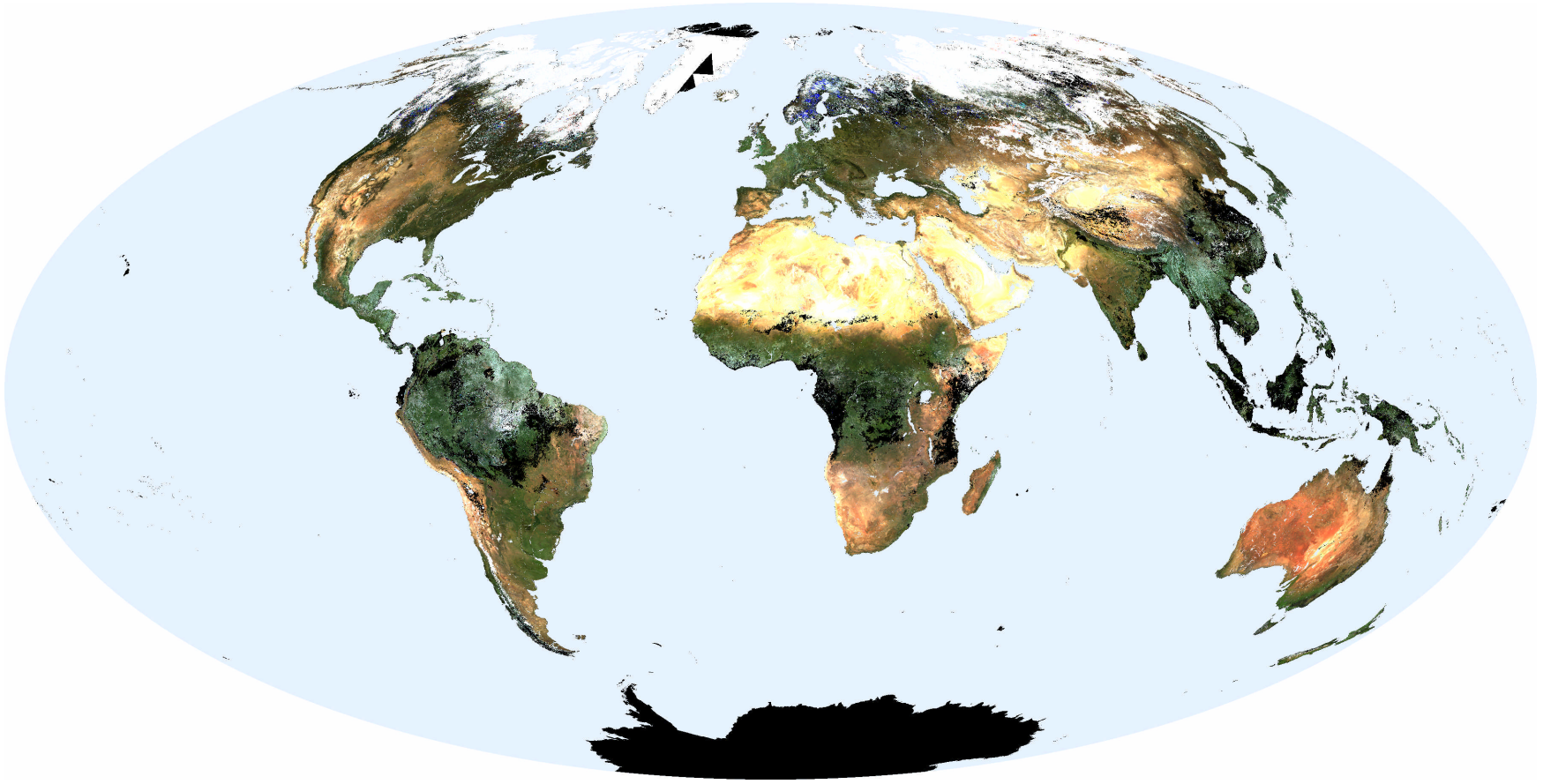


31 October-15 November,2000 (Day 305)

NIR (0.10 - 0.40) Red (0.00 - 0.16) Blue (0.00 - 0.15)

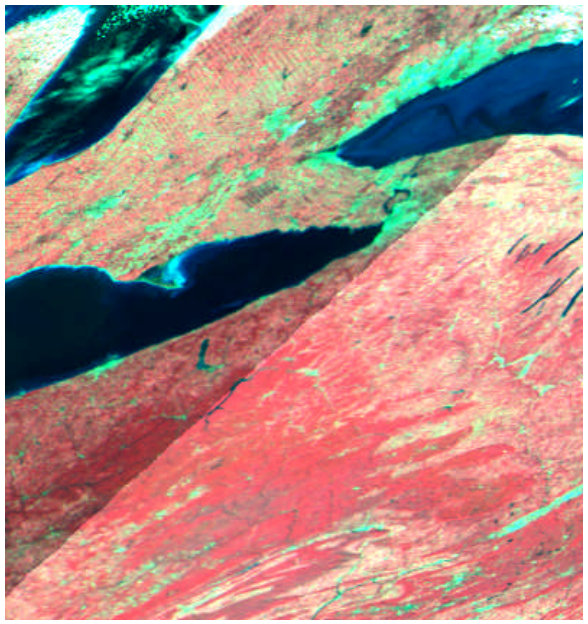
Global Composite Map of Nadir BRDF-Adjusted Reflectance (NBAR)

Sept. 29 - Oct. 30, 2000

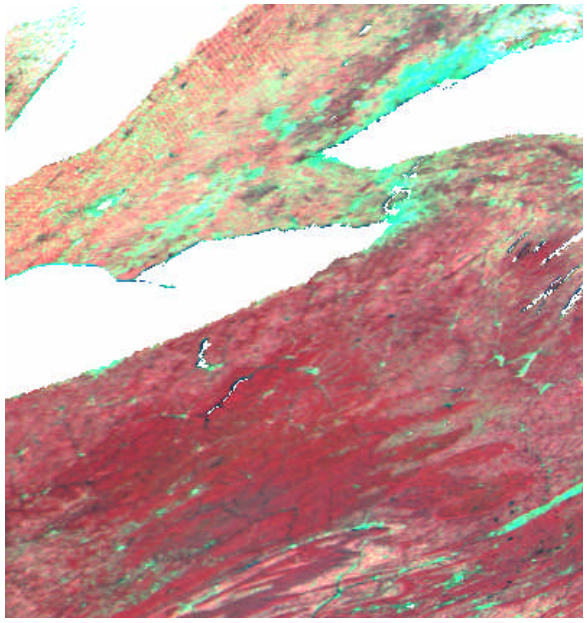


no data

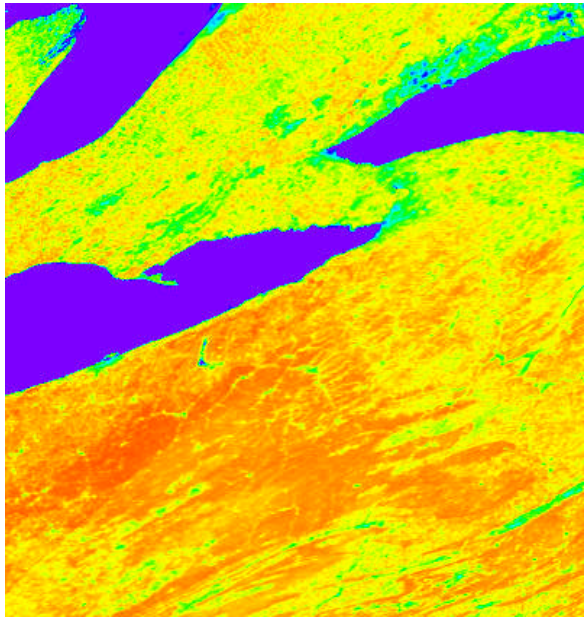
Red (0-0.20) Green(0-0.20) Blue(0-0.20), 10 km resolution, Hammer-Aitoff projection, produced by MODIS BRDF/Albedo Team



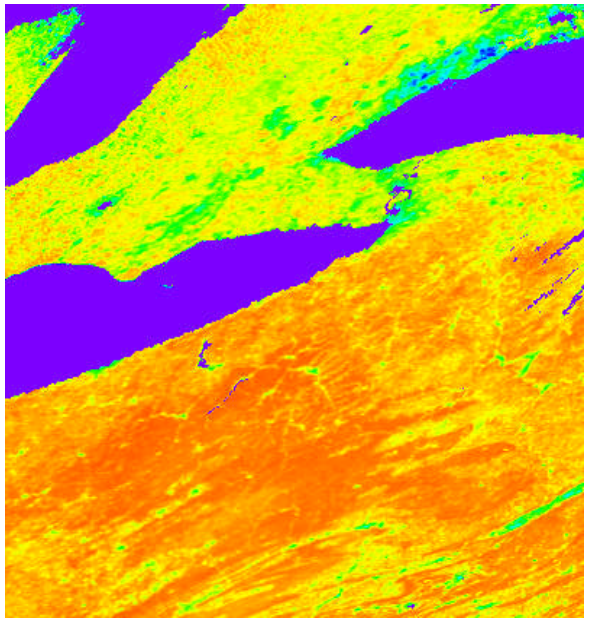
Tile: h12v04
Pixels (1,712)-
(400,1111)
Julian day: 2000250
(Sept. 6, 2000)



Original MODAGAGG NIR(0.1-0.45) Red(0-0.1) Green(0-0.15) NBAR (MOD43B)



0.1 1.0



NDVI map from MODAGAGG NDVI map from NBAR

MOD43B MODIS BRDF/ALBEDO VALIDATION

Beltsville Agricultural Research Center (BARC), Maryland, USA
(S. Liang)

Barton Bendish, East Anglia, UK
(M. Barnsley)

Mongu, Zambia (SAFARI 2000 Southern African Regional Science Initiative)
(J. Privette, G. Roberts)

Luancheng, China
(X. Li)

MODIS Snow Maps

Daily and 8-day composite maps released on September 13, 2000

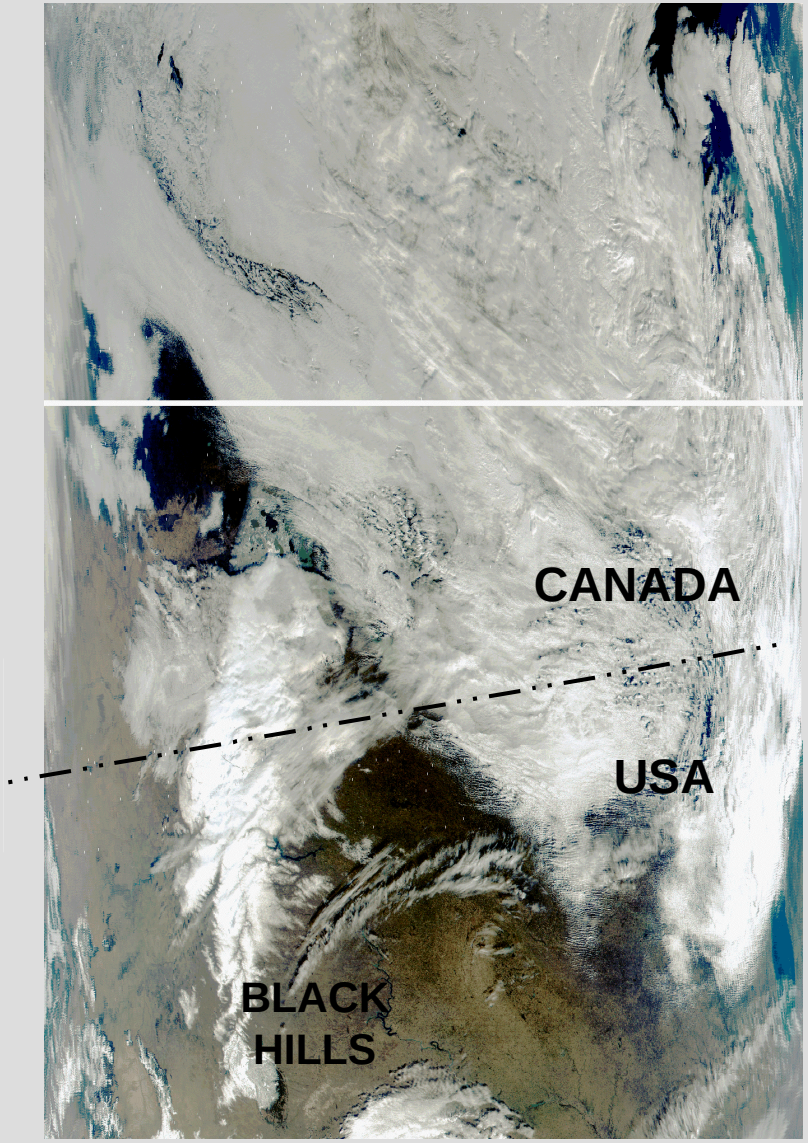
Special daily and 8-day composite climate-modeling grid products developed for modelers

Validation:

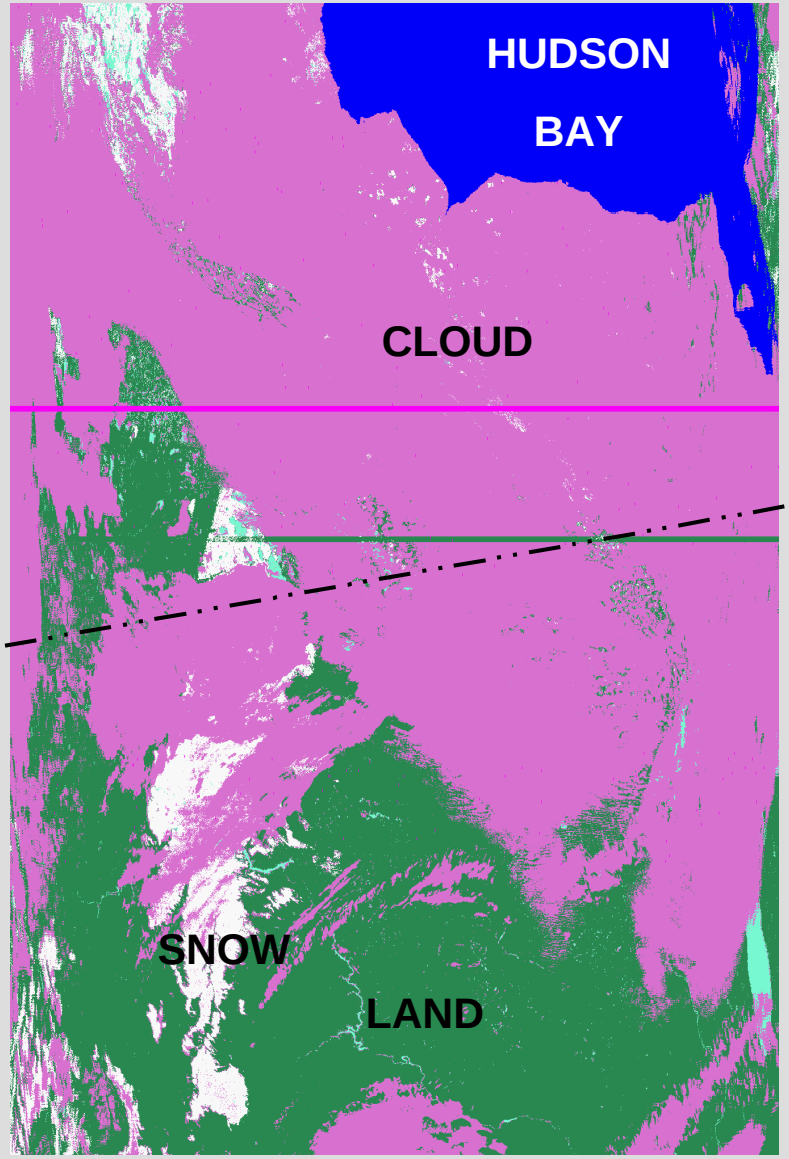
- Field work & ER-2 overflight - March 6, 2000
- Field work - winter 2001 (northeastern U.S.)
- MODIS maps are compared with ETM+, NOAA operational maps and SSM/I-derived maps

Concerns are: cloud confusion and some false snow detections

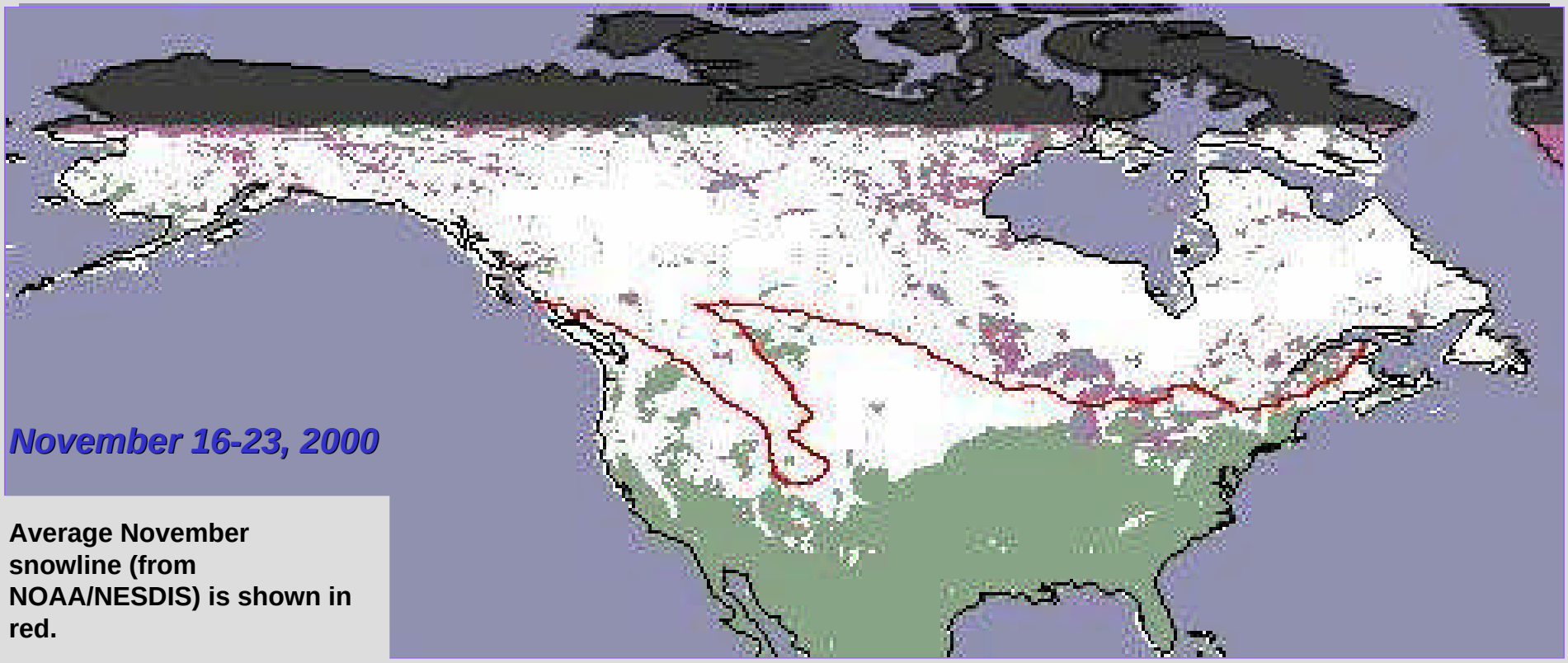
MODIS Image and snow map - November 3, 2000



MODIS bands 1, 4, 3



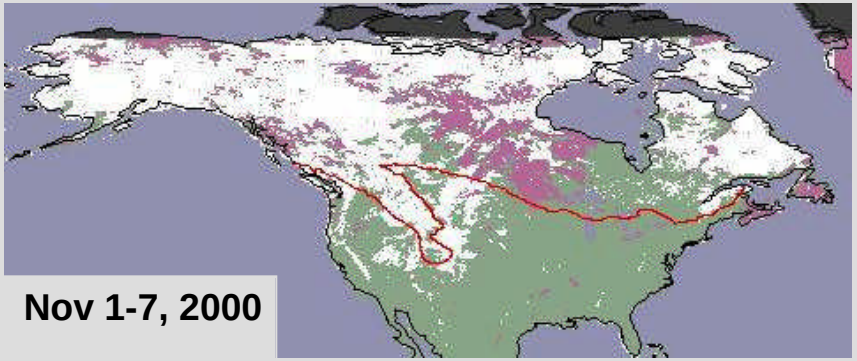
8-Day Composite Snow Maps on Climate-Modeling Grid



November 16-23, 2000

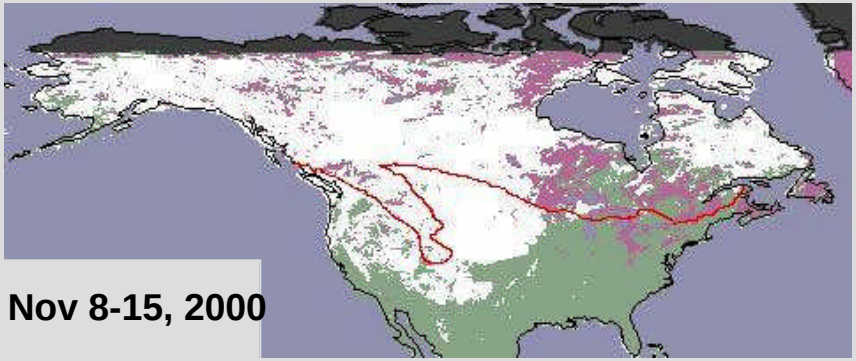
Average November snowline (from NOAA/NESDIS) is shown in red.

9.0 million sq. km of snow cover



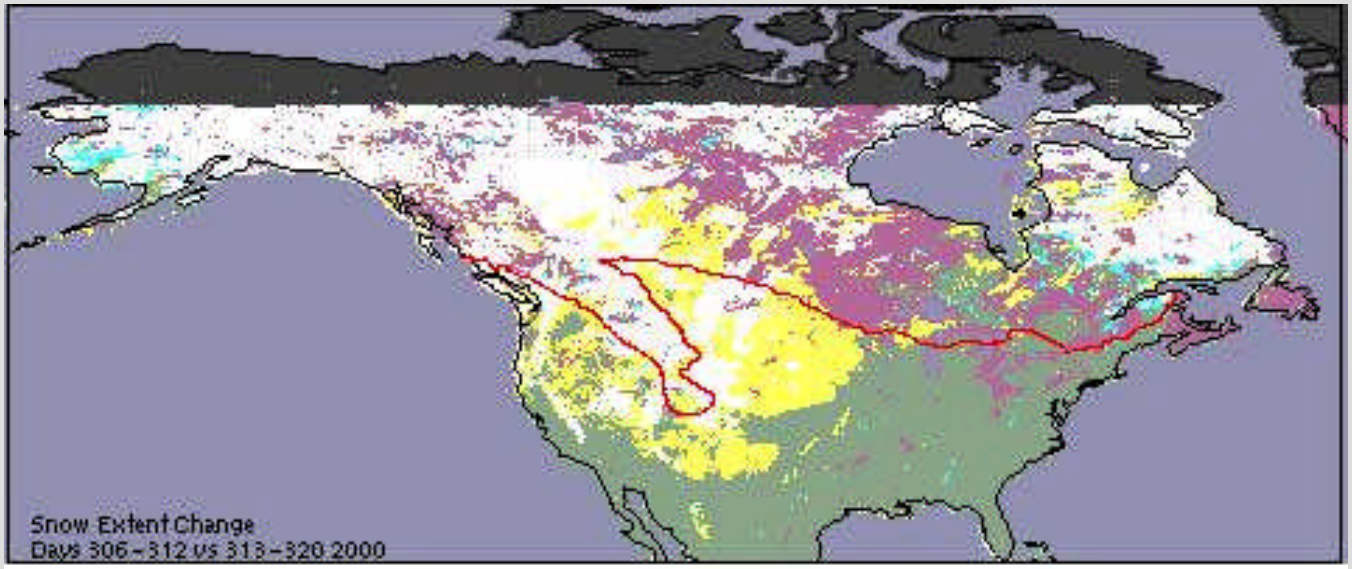
Nov 1-7, 2000

10.8 million sq. km of snow cover



Nov 8-15, 2000

Change in maximum snow extent between two composite periods seen above (1.8 million sq. km)



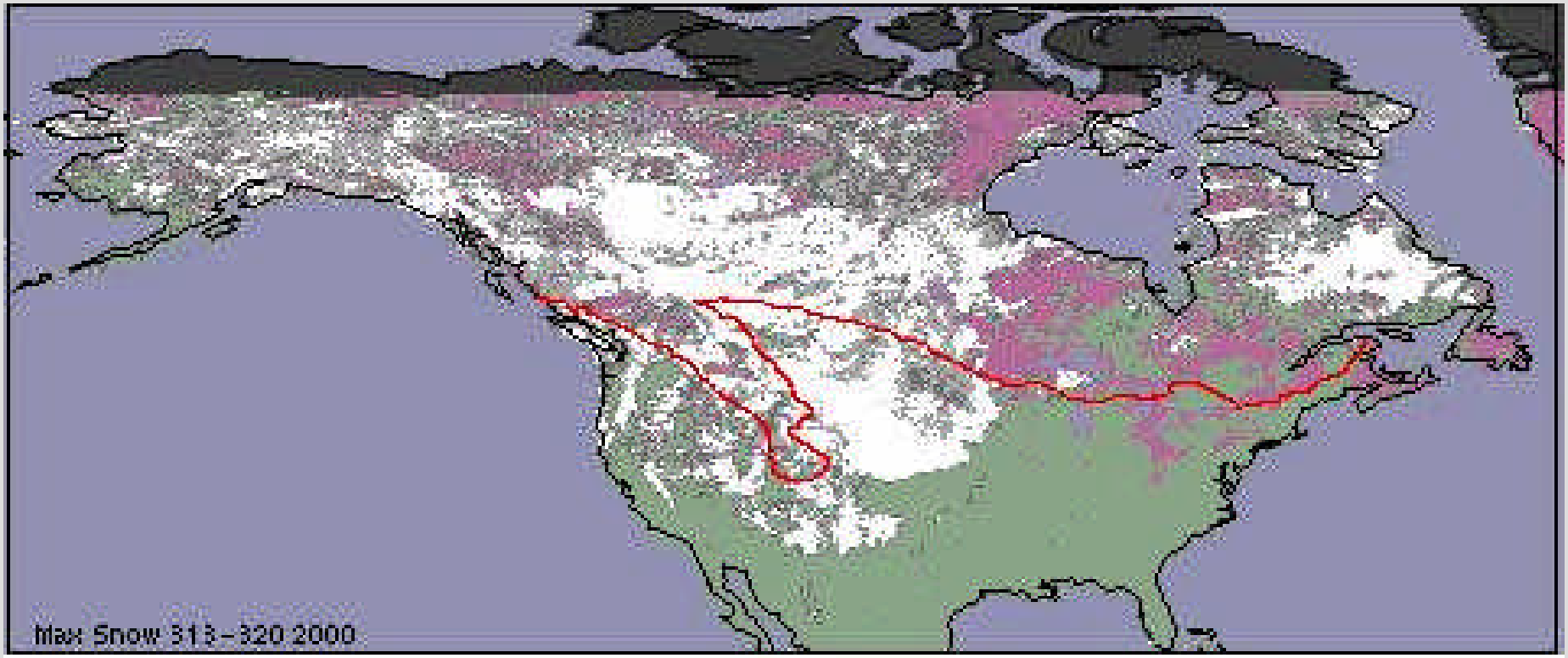
Snow on both

Snow on Nov 1-7 only

Snow on Nov 8-15 only

Clouds

Fractional snow cover as derived from the maximum snow cover map for the period November 8-15, 2000



>80 snow cover 50-80% snow cover 20-50% snow cover clouds

Near-Term Future Work

- Snow albedo algorithm delivery - spring 2001
- Field work - January & February in NH & NY
- Snow/cloud confusion; analysis continues
- Fractional snow cover for 500-m maps- two candidate algorithms are being tested for anticipated summer 2001 release
- CMG maps to be used in models (DAO and ClimRAMS)
- MODIS/AMSR algorithm development for snow cover/snow-water equivalent maps
- Regional validation (ETM+, SSM/I, NOHRSC & NESDIS) continues

Status of the MODIS LST Product

Beta release of 1km daily L2/L3 LSTs since late July, 1km 8-day L3 LST since late August, 2000.

The daily LST product was validated with ground-based measurement data at Lake Titicaca, Bolivia, and Mono Lake, California.

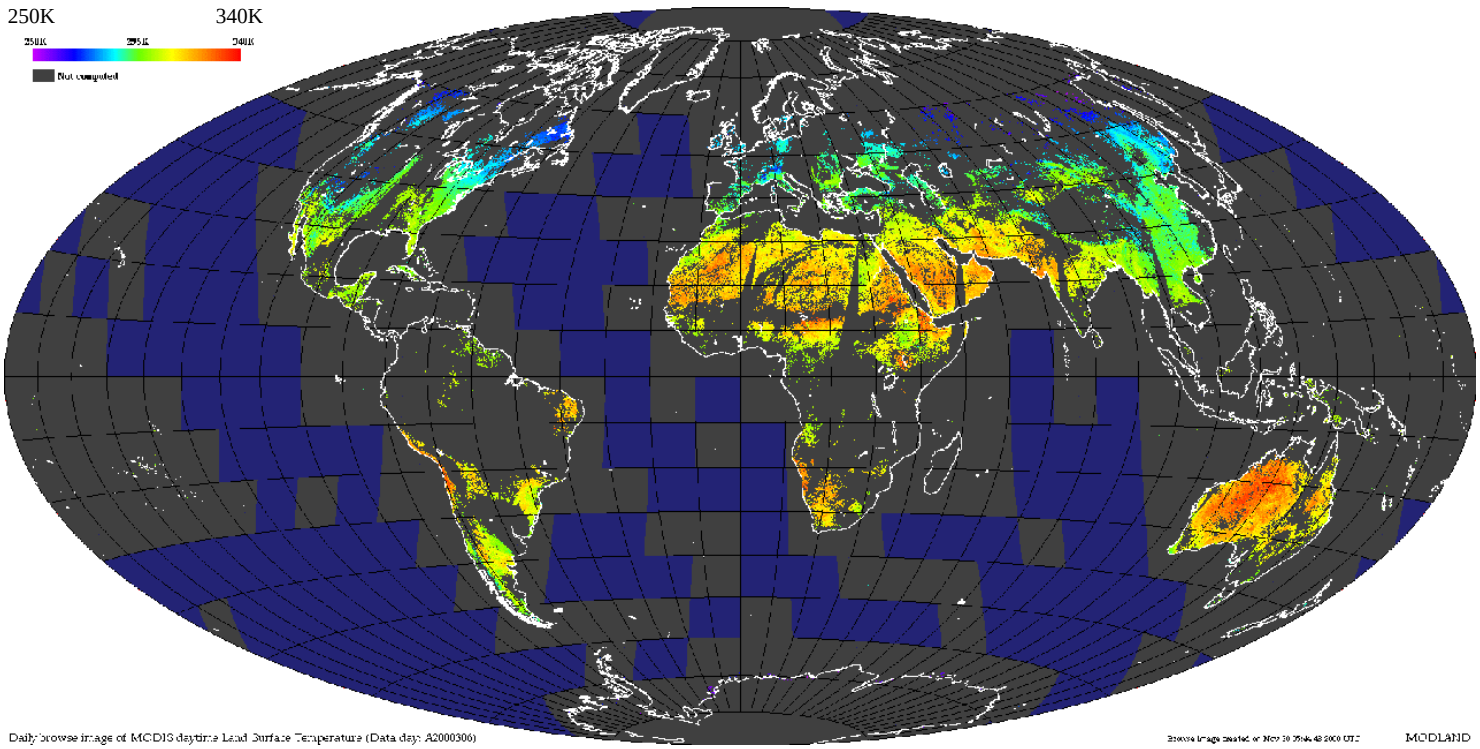
It was validated at grassland and rice field sites in California, also as the outreach activities for LST applications in agriculture and environmental monitoring.

ICESS
Institute for
Computational Earth System Science
University of California, Santa Barbara

Status of the MODIS LST Product

Global browse image at 5km resolution of the daytime 1km LST product from first B-side MODIS data

A2000306 (11/01/2000)

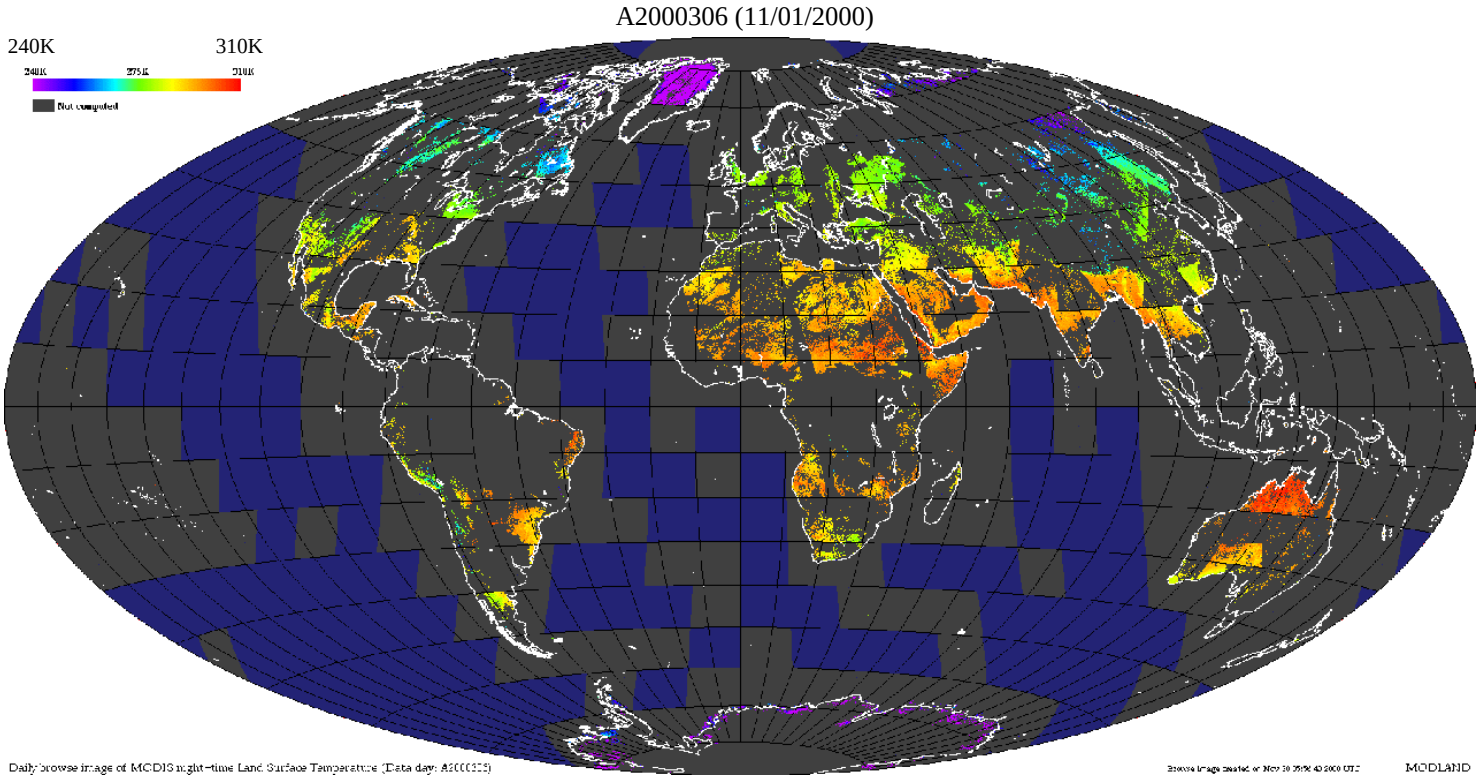


Courtesy of MODAPS, MODLAND, and LDOPE

Institute for
Computational Earth System Science
University of California, Santa Barbara

Status of the MODIS LST Product

Global browse image at 5km resolution of the nighttime 1km LST product from first B-side MODIS data



Courtesy of MODAPS, MODLAND, and LDOPE

Status of the MODIS LST Product

The 1km daily LST product will be validated in semi-arid and arid areas in 2001.

The 5km daily LST product is being evaluated, its Beta release will be in 2001 as the qualities of L1B and atmospheric profile products improve.

It is expected that the quality of the LST product from Aqua MODIS data, especially the 5km product by the day/night algorithm, will be improved significantly.